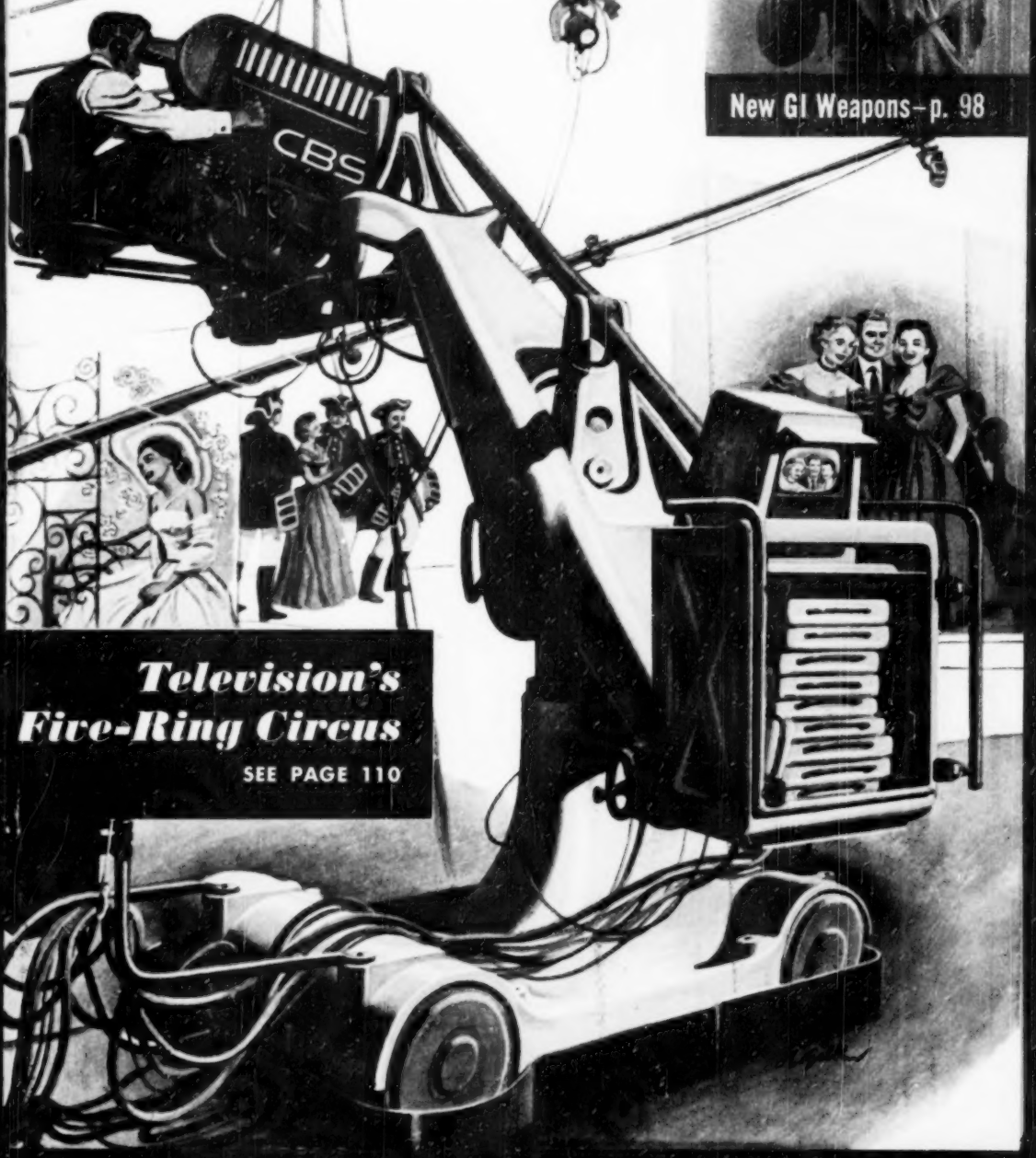
POPULAR SCIENCE

MECHANICS AND HANDICRAFT

October, 1950
25¢

New GI Weapons—p. 98



Television's Five-Ring Circus

SEE PAGE 110

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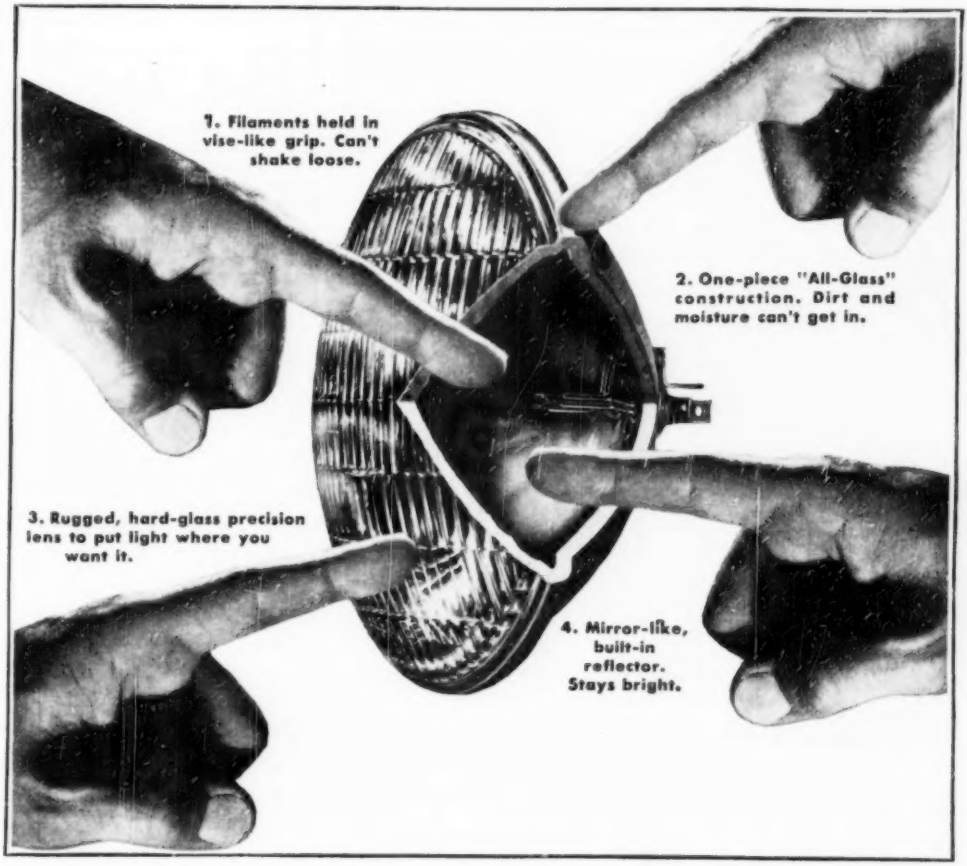

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Founded 1872. Vol. 157: No. 4

POPULAR SCIENCE
REG. U. S. PAT. OFF. *Monthly*

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Features FOR OCTOBER, 1950

The Cover:
For this PS cover painting artist Denver Gillen sketched TV's "Monster" during Fred Waring show.

New GI Weapons 93
From the Korean battleground came the call for more built-in firepower. Here's our answer.

Nashes Get a Speedway Workout .. 105
Wilbur Shaw, boss of the Indianapolis Speedway, gives the gun to the smart new '51 models.

TV Tricks Make Better Shows 110
Backstage in a TV studio you wonder the show ever gets on the air. Here's how they do it.

Guided Missiles Have Radar Eyes 124
Can a sneak A-bomber get through? A flying torpedo, with a vacuum-tube brain, says no.

Titanium: Our Next Major Metal? 146
Spilled salad oil played an important role in the development of titanium for commercial use.

The Village Welder 156
He's taken over the old blacksmith shop and performs miracles with an oxyacetylene torch.

Vacuum Is Also Carpet Sweeper .. 166
This combined vacuum cleaner and carpet sweeper gulps dust from your house like crazy.

How to Button Up Your House ... 177
Follow these directions and you'll save dollars and also make your house warmer this winter.

Need Furniture? Try Shiplap 186
Siding with built-in rabbets costs little, and it's a cinch to build drawers with it.

Gus Has a Noisy Day 190
There's a lot of talk, but Gus cuts through the red tape and makes a matter out of chatter.

What About Horsepower? 199
A horse is a horse in any man's language, but here's how they're harnessed to power.

How to Hide Radiators 229
Putting radiators under cover saves money, and also adds attractive furniture to your home.

Elephant Is Gas-Powered 118
Ford Plus Willys Is Sports Special 120
House Built-In-The-Round 123

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Trawler Brings Fish in Packages.....134
Helicopter Firemen.....138
First Billion-Volt Atom Smasher.....140
Inside Story of Footballs.....142
Laundry Renews Spark Plugs.....154
Navy's Arctic Houses Ride Sleds.....161
Hitler's Flivver Sold in U. S.....163
Custom Car Built Like Luxury Office....165
New Fiat Is Big Car in Miniature.....171
Roll-Over Test Checks New Cars.....173

Mechanics & Handicraft

Black Sunshine Keeps Us Warm.....183
Why Litter the Highways?.....195
How to Make UN Flag.....197
Cosmetic Aids for Craftsmen.....198
Inside Stuff for Your Car.....204
Power Tools Ride on Casters.....209
Washer Gears Saw Firewood.....211
Supersaw Tackles All Jobs.....212
It's Fun to Fix a Sewing Machine.....215
Soft Water Saves Money.....221
Waste Heat Warms My Basement.....224
Leather Tooling by an Expert.....226
Chain Reaction Lights Photos.....232
C-Clamp Vise Has Soft Jaws.....237
Are You Saving P.S. Data Cards?.....238

Departments

Letters 8
New Ideas from the Inventors.....103
I'd Like to See Them Make.....164
Keeping the Home Shipshape.....169
Aids to Modern Living.....174
Hints from the Model Garage.....193
What's Wrong? 219
New Shop Ideas.....234
Mechanics of Farming.....254
New Tools.....282
P.S. Last Minute News and Notes.....286

Are You Ready, Santa?

THROUGH the hot summer months, POPULAR SCIENCE researchers have been attending toy fairs, questioning children, and preparing to tell you how to make finer Christmas gifts than ever before. They've been amazingly successful.

So start saving the scraps of wood and other odds and ends and see—in next month's POPULAR SCIENCE—how you can turn them into novel and sure-to-be-popular Christmas Toys.

Saving energy for better low-cost telephone service

Arrow points to tube containing a wire specimen under test for surface conductivity. The tube and wire are excited to resonance by microwaves from generator at extreme left. Conductivity is calculated from frequency values indicated by barrel-shaped wavemeter (top center) and resonance curves traced on an oscilloscope screen (not shown).

In the waveguides which conduct microwaves to and from the antennas of radio relay systems, current is concentrated in a surface layer less than 1/10,000 inch thick, on the inner surface of the waveguide. When these surfaces conduct poorly, energy is lost.

To investigate, Bell radio scientists devised exact methods to explore this skin effect at microwave frequencies. Scratches and corrosion, they found, increase losses by 50 per cent or more. Even silver plating, smooth to the eye, can more than double the losses of a polished metal. Very smooth conductors, like electropolished copper, are best. An inexpensive coat of clear lacquer preserves initial high conductivity for many months.

Energy saved *inside* a microwave station can be used in the radio-relay path *outside*. So stations can sometimes be spaced farther apart, with more margin against fading. Here is another example of the practical value of research at Bell Telephone Laboratories.

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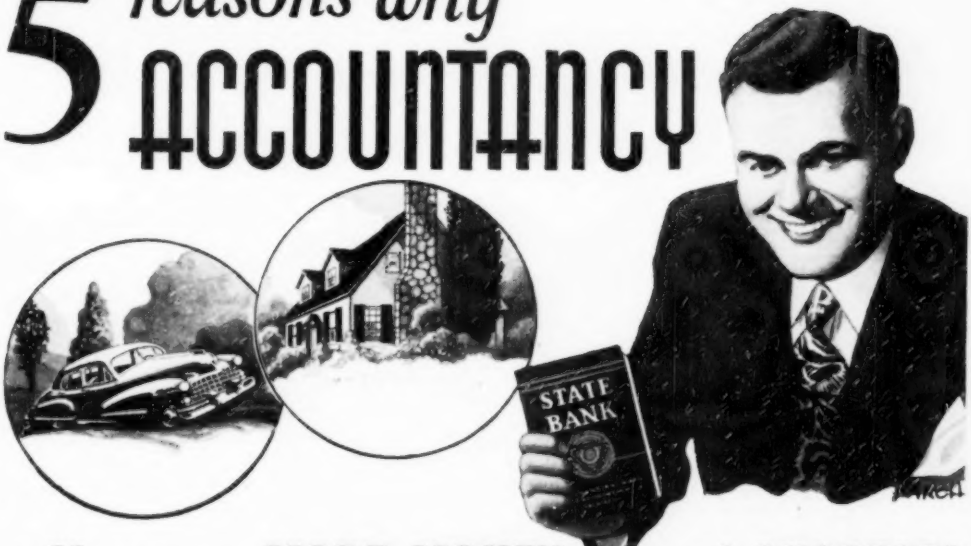

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Letters

Tool Rule

Sir:

It seems to me that hour-long lectures on the care of tools could be reduced to one

sentence: Never use a tool for any purpose for which it was not designed.

JOHN W. NESTLER

Tampa, Fla.

Remodeling the Model A

Sir:

I agree with PS reader L. G. Pollock [July, p. 12] that Ford should bring out a slight revision of the Model A to meet today's need for a practical, low-priced car. But he's 'way off on the three changes he suggests: hydraulic brakes, steering-column shift, and modernized body. All the Model A needs to bring it up to date is safety-glass windows, sealed-beam headlights, and better shock absorbers.

FREDERICK F. SCHLOETZER

Honolulu, T. H.

. . . disk wheels would be handy.

WILLIAM L. ALLEN

College Park, Md.

. . . solid metal top.

REID BUSHMAN

Tooele, Utah

Six Little Engines

Sir:

Just a few lines to tell you how I've practically gone into the engine-building business as the result of your description of the hot-air engine by Mr. Floyd McGuckin in PS last February [p. 206].

I machined a set of castings that I bought from him, and the little engine started off the first turn and ran to beat the band. But when my grandson saw it, he

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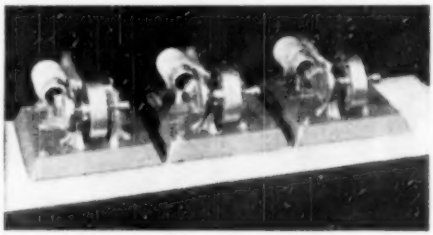
just had to have it for himself. Then, having another grandson and a neighbor boy who also was interested, I ordered five more sets of castings.

Now I have finished six engines in all, and they all run perfectly. Trouble is, I'm almost afraid to show them to anybody for



fear my pride would only result in more work. In thanks to you, however, I enclose a snapshot *[above]* showing three of them going at the same time.

WALDEMAR G. HANSEN

W. Los Angeles, Calif.

Hexed Dies

Sir:

In your August issue, page 190, Walter F. Troop says "I'd like to see them make" rethreading dies shaped like a hex nut so they could be turned with a wrench instead of a diestock. Where has Mr. Troop been all these years? Hex-shaped chaser nuts, or dies, are for sale at any of the large hardware stores.

ALBERT E. KIRK

Galveston, Tex.

. . . the Diesel locomotive plant where I work carries these die nuts in its tool cribs.

GENE STUDER

Cicero, Ill.

. . . been using them five years.

R. W. FAULKNER

St. Louis

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CAREY F. WENTZ

Fort Peck, Mont.

. . . Blue Point Set No. TD-2400, made by Snap-On Tools Corp., Kenosha, Wis., goes Mr. Troop one better. This set has 12-point shaped dies that can be used with a 1" 12-point deep socket and are wonderful

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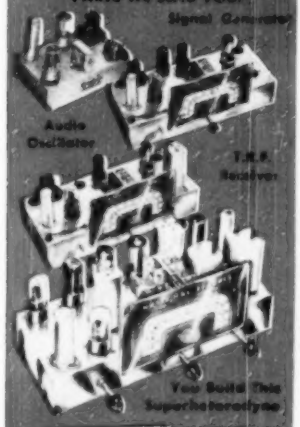

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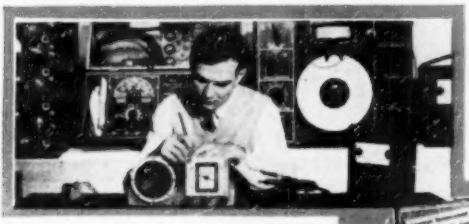

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CARLTON AUSTIN

Terryville, Conn.

Sharp-eyed PS readers have told embarrassed PS editors of nearly a dozen tool makers who were 'way ahead of contributor Troop with this handy idea.

Safety Seal

Sir:

Let me add a suggestion to those in the article, "Making the Death Seat Safer," in your July issue, p. 82. My idea is an engine governor that would be set to keep a car from exceeding the speed limit in whatever state it was operated. This control would be set—and sealed—by an authorized official. It would be illegal to break the seal except in case of emergency. The state highway patrol would check cars at random; and whenever they found a broken seal, the

car's owner would have to offer an acceptable explanation—such as taking somebody to the hospital.

B. J. STEPHENSON

Angier, N. C.

How Spark Coil Works

Sir:

Last April, page 187, you purported to explain how a spark coil works on a car by saying: "A rotor in the distributor breaks the battery circuit. High voltage induced in the spark coil sends a spark across the plug gap."

Don't the breaker points break the battery circuit? I've always been under the impression that the rotor, as it turns, distributes secondary voltage to each consecutive spark plug in firing order. Am I wrong?

CPL. TRUMAN A. WILLARD

Wichita Falls, Tex.

PS erred in terminology. A rotating cam opens the breaker points, interrupting the

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Learn how to protect your invention. The U. S. Patent Laws provide that any new and useful art, machine, article of manufacture, or composition of matter, or any new and useful improvement thereof, may be patented if the act of invention is involved. Therefore, every inventor with a valuable invention should take advantage of the Patent Laws and proceed for patent protection in order to safeguard his rights.

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battery circuit. The rotor, located under the distributor cap, distributes the high-voltage surge to the particular cylinder that's ready to fire.

Constant Reader

Sir:

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BOONE RILEY

Los Angeles

TV-Photo Hobby Catches On

Sir:

A couple of years ago I tried to start the hobby of "telephotography" for those who were both television and camera fans. Judging by the number of fans who got in touch with me, it seemed to go over very well.

During the ten years I have been taking snaps off my sets, yours is the first contest I have heard about, and I want to thank you for taking an interest in this hobby.

WM. A. J. DEAN

Chicago

For the first samples of PS readers' TV photos, see page 128.

Rising Prices

Sir:

Your writeup on the cartridge-loading blowtorch in July, page 90, gives its price as $5.95 and 89 cents for refills. But when I ordered one, enclosing a postal note, the company wrote back that for an extra $2 I could have the torch, and that refills were $1. It seems queer that two errors could be made in the same article.

W. M. HELPHREY

Chicago

Prices of the Prepo home torch and fuel, reported correctly by PS as of the time the article was written, were hiked just after the magazine went to press.

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Unless you are fully familiar with the U. S. Patent Laws, we recommend that you engage the services of a Registered Patent Attorney to protect your interests. The patent laws are *your* laws. A patent gives you the right to prevent others from making, using or selling the invention claimed in your patent for a period of 17 years.

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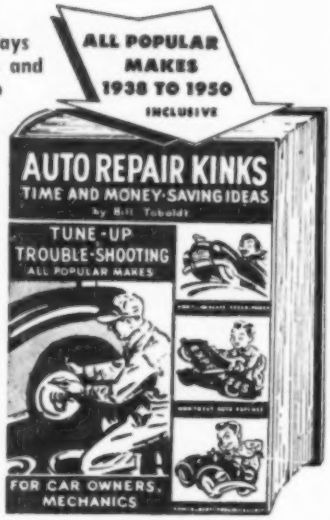

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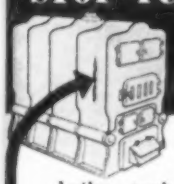

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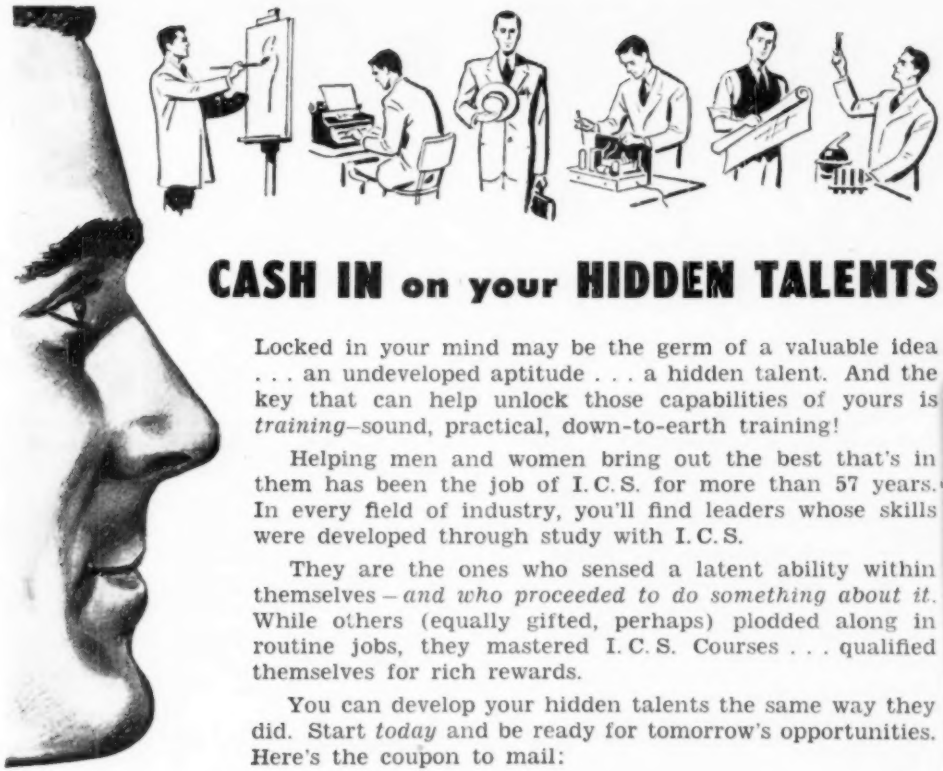

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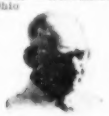

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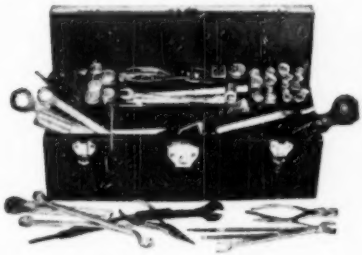

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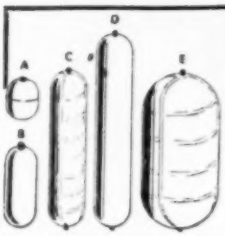

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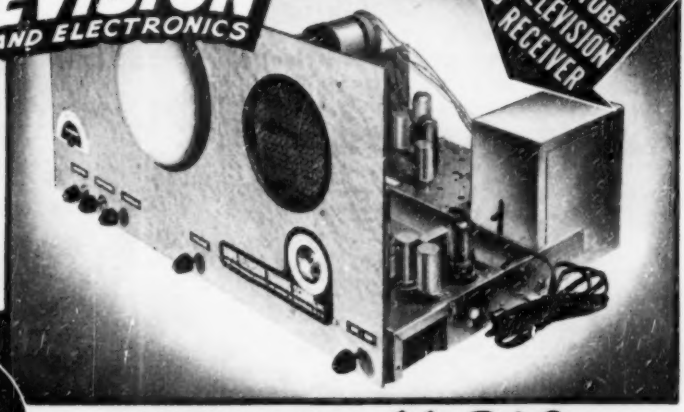

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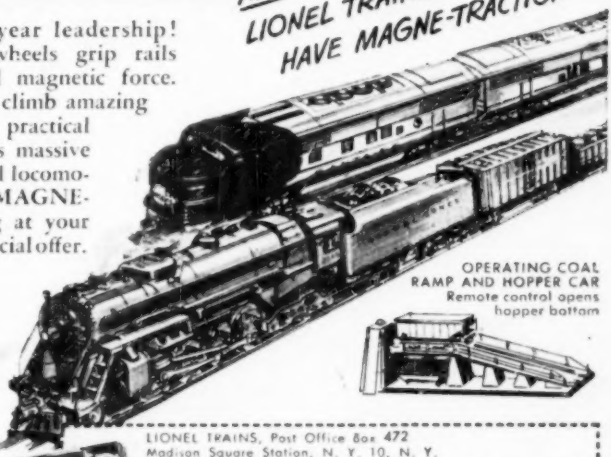

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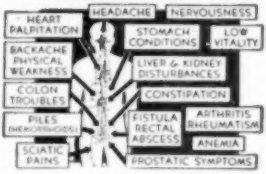

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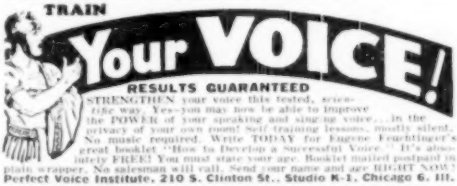

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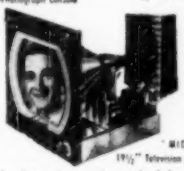

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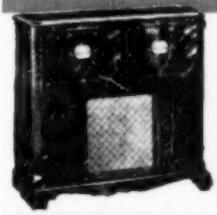

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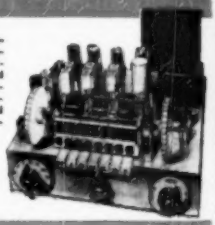

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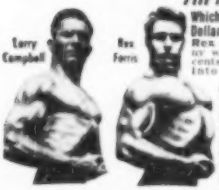

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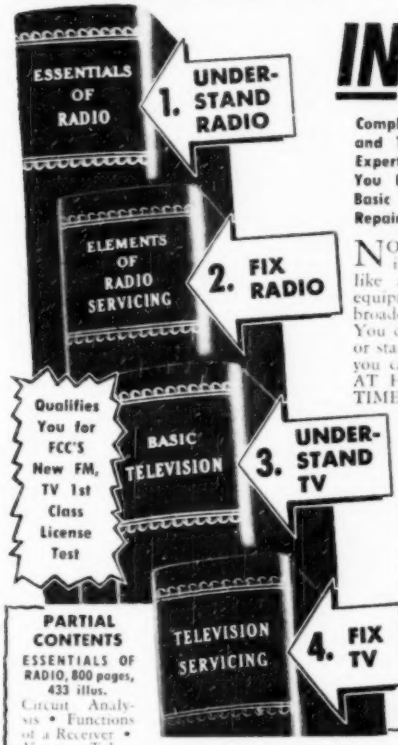

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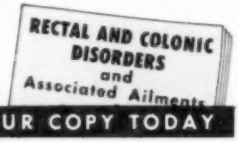

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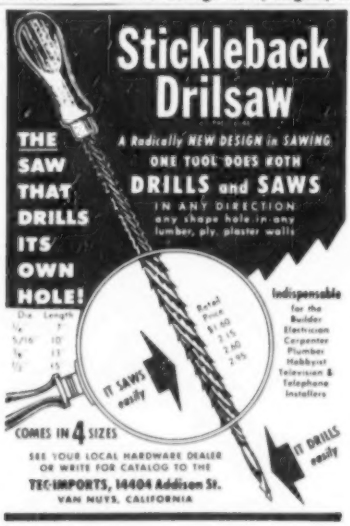

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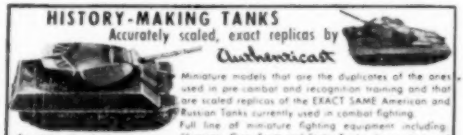

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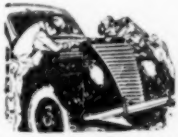

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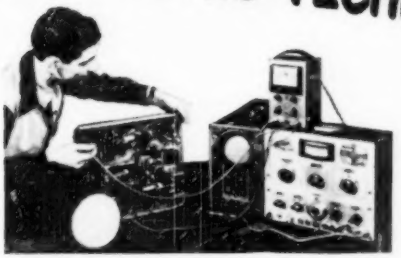

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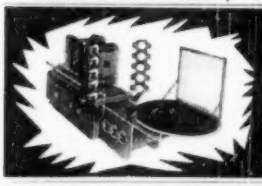

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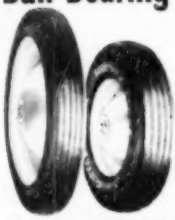

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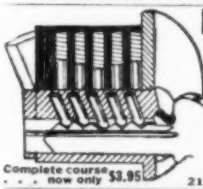

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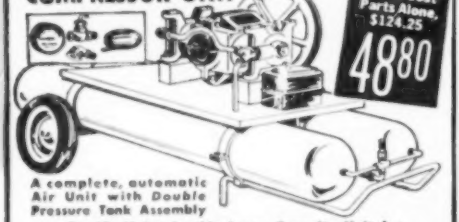

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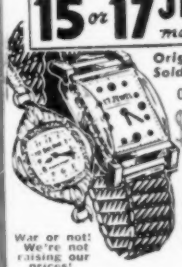

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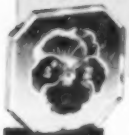
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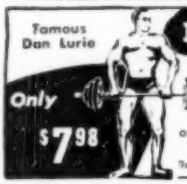

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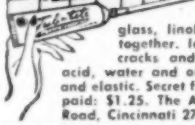

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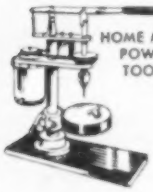

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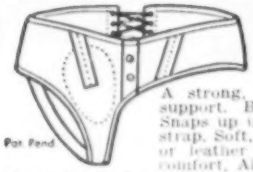

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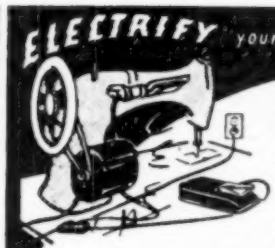

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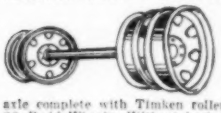

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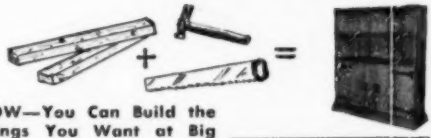

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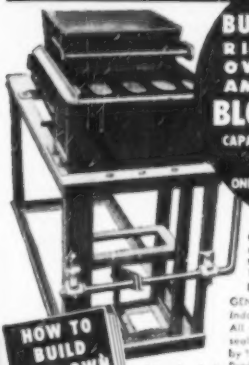

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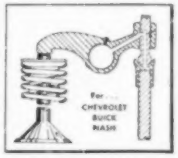

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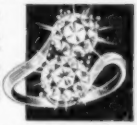

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WRITE for free booklet and catalog telling how to earn substantial profits in your spare time by forwarding new and renewal subscriptions to all magazines for your friends and neighbors. Oldest U. S. Agency. Established 1869. Moore-Cottrell, North Cohocton, New York.

MAKE Money spare or full time casting Metal Toys and Novelties. Big wholesale and chain store demand for Autos, Soldiers, Ashtrays, Banks, etc. keeps manufacturers busy. Production moulds furnished for up to 100 and more castings per hour. No experience or special place necessary. "Cash-in" on holiday orders now being placed. Write for information and illustrations of patterns needed. Metal Cast Products Co., Dept. E, 1696 Boston Road, New York 60, N. Y.

OPERATE Hosiery Run Mending Service. Pleasant! Freed's, Box 115, Chicago.

DOLLARS Daily mailing postcards! Proof! Power Publishers (C-9) Cincinnati 36.

START Mailorder Bookshop—Everything furnished. 25c brings booklet, samples, exciting ideas. General Publications, Ossining 1, New York.

$124.50 WEEKLY Guaranteed! At home, sparetime. $1.00 (deposit). Science Syndicate, San Antonio, Texas.

A FACTORY in your home, garage! Mechanics' waterless hand cleaner, glass cleaner, auto cleaner-polish; many others. All formulas free, but if you also want free samples, send 15c postage. Western Aircraft, Dept. G, Los Angeles 6.

BRONZECRAFT Baby Shoe Mountings. All Metal Bookends. Ash Trays. Picture Easels—Beautiful Designs—America's Lowest prices. Sample mounting $1.00 prepaid. Baby Shoe Electroplating Instructions Free. Bronzecraft, 630 Newark Ave., Jersey City, N. J.

HOW To Set Up and Run A Mirror Shop! Resilver Mirrors. Make Chipped Glass Nameplates. Electroplating Salts and Rectifiers. John Sprinkle, V90, Marion, Indiana.

RECAST old batteries into new. Latest achievements. Battery Laboratories, Minneapolis.

57 MONEY MAKING OPPORTUNITIES

LEARN Sewing Machine Repairing at home. Earn $125.00 week spare time. Plus new machines, motors, etc. Wholesale. Free Particulars. Taylor Service Co., Hamilton, Ohio.

DETECTIVES Earn Big Money. Experience unnecessary. Detective Particulars free. Wagoner, P-125 West 86th, N. Y. 24.

EXCELLENT profits. Make fast-selling chenille Christmas poinsettias, corsages, Santas, monkey trees, dolls. Literature free. Velva, Dept. X, Bohemia, N. Y.

NO selling, operate coin machines, amazing profits, details Free. Parkway Corporation, Dept. 18, 715 Ensor Street, Baltimore 2, Maryland.

INDEPENDENT income! Make leather belts, billfolds, purses. Big catalog and genuine steerhide keyholder, 10c. Tandy Leather, Box 397G, Tulsa, Okla.

SCHOOL Seniors — Earn sensational profits selling classmates America's Most Beautiful Graduation Name Cards. Largest selection. Outsells all others. Free sample kit. Printcraft Dept. P, 1425 E. Elm Street, Scranton 5, Pa.

ADDRESS mail circulars for advertisers. Complete instructions—List of firms—25c. Imperial, PS-8, Wilmington, N. Car.

QUICK profits taking magazine subscriptions, handling greeting cards. Cassell Publishers Service, Westfield, N. J.

WIN contest money. General Contest Bulletin gives hundreds of tips. Lists current contests and rules. Sample 25c. General Contests, 1609-A East 5th, Duluth, Minn.

COLORED and light reflecting crystals. Luminous pigments. Catalog and Samples 25c. Glowell Co., 475-E, Fifth Ave., N.Y., N.Y.

HOME Envelope Addressers! Latest Issue: "How to contact 100 Mail Order Houses." $1.00. Tralist, Box 2160, Seattle 11, Wash.

BARGAINS, new and used arc welders, Electric or gas engine, AC or DC, all sizes, portable or stationary. Write needs. Hobart Welders, Box P-1004, Troy, Ohio.

NEW Patented Hobby-horse. It walks. It rocks. Exclusive territory. Manufacturing rights. Free details. Carl Markowski, Lewiston, Idaho.

A $100-A-Month hobby at home! No soliciting, no mail order, no meeting people. Easy enjoyable pastime. Details 25c (Refundable). Laura Dickson, 1006-PS Elizabeth Street, Anderson, S. C.

ASSEMBLE and Sell Swiss Musical Churches Kit $3.95 Postpaid. Tremendous Seller. Piltzecker Imports, Wood-Ridge, N. J.

RECEIVE Mailbag Free Merchandise! Postal brings "items" list. Athans, 2815-C Vaughn, Ft. Worth 5, Texas.

VENDING Machines, Punchboards, Free Catalog. Tyrcha Wholesale, 4532 N. Meade Avenue, Chicago 30, Ill.

MONEY from Water, Salt and Air. Send $1.00 for copyrighted information. Box 1372, Des Moines 5, Iowa.

$250 WEEK Reported! Free illustrated book "505 Odd Successful Businesses." Work home! Expect something odd! Pacific-E, Oceanside, California.

EARN Money Evenings, copying and duplicating comic cartoons for advertisers. Adservice, Argyle 2, Wisconsin.

NEW Envelope Savings and Accounting Record Sample $2.00 1950 Taxsaver Included. Taxsaver Sells The Record For You. Taxpayer Records, 1044 Midland Bank Building, Minneapolis, Minnesota.

PUT each $1.95 in your pocket. It's yours! Take orders for famous personalized door mat retailing at $4.95 (customer's name molded in). We ship, collect balance. Hurry. Make all Christmas expenses and more. Details free, write R. L. Mitchell Rubber Co., Dept. 10-P, 2124 San Fernando Rd., Los Angeles 65, California.

58 FORMULAS, PLANS, ETC.

FORMULAS—All kinds. Latest products. Literature free. Kemico, Park Ridge 15, Ill.

LABORATORY tested formulas. Lists free. Pont, Box 635-PS, Terre Haute, Ind.

10,000 FORMULAS and Trade Secrets. Free Literature. Stillmans, 555 Kingston Ave., Brooklyn 3, N. Y.

BRONZE Baby Shoes. Complete Plating Formulas and Instructions $2.00. Plastics, Box 1374, Boston 4, Mass.

59 PLASTICS

LUCITE, Plexiglas. Any size sheets masked. Square foot (12 x 12) cost 1/16", 96c; 1/8", $1.25; 3/16", $1.52; 1/4", $1.80. Colors add 10%. Include 10% postage. Almac Plastics, 230 Fifth Avenue, New York 1, New York.

NEW Liquid plastic. Clear, colors. Cast without heat. Embed flowers, insects, coins. Saw, drill, carve. Send 25c for exciting new home project manual showing how to get started. Castolite, Dept. K-102, Woodstock, Illinois.

CARVERS—Spherical-faced blanks—Free List. D. Niehaus, 6754 Vernon, University City, Missouri.

LUCITE, plexiglas, Acetate, 85 different colors, thicknesses. Immediate shipment from stock. Rod, Tube, Casting plastic. Wholesale, retail. Catalog, instructions, bargain lists, 10c. Gem-O-Lite, Box 686Y, North Hollywood, Calif.

INTERNAL carved roses, orchids, swans, goldfish, butterflies, etc. Jewelry and gifts. Crystal Floral Novelty Co., Bound Brook, New Jersey.

INTERNAL carved flowers in jewelry, finished and unfinished. Wholesale prices. Free leaflet. Handcraft Products, Box 134, Elmhurst Station, Oakland, California.

PLASTIC Sheets, Rods, Tubes, etc. Free List. Plastic Supply Co., 2901 N. Grand Blvd., St. Louis 7, Mo.

FREE Plexiglas listing. Unique Glass Shop, Box 4195, Richmond, Virginia.

COMPLETE line internally carved gifts and jewelry. Free catalogue. Pilot Plastics Co., 69D Fulton St., B2, N.Y.C. 7.

PLASTICS, Profitable Hobby. Learn to Carve. Instructions, Catalog 25c refundable. Plastic's, Box 1812, Salt Lake City 10, Utah.

INTERNAL carved flowers in jewelry, finished and unfinished. Wholesale prices. Free leaflet. Handcraft Products, Box 134, Elmhurst Station, Oakland, California.

60 CHEMICALS AND APPARATUS

COMBINATION Offer: Chemical balance, experiment book, catalog of laboratory supplies, $1.00. Catalog only 10c. Rex Laboratories, 2849-B Birchwood, Chicago 45, Illinois.

CHEMICALS and apparatus for industrial, analytical, and private laboratories. Catalog 15c. Dept. M-26, Biological Supply Co., 1176 Mt. Hope Ave., Rochester 20, N.Y.

ILLUSTRATED Catalog: Chemistry, mineralogy, biology, 10c. Tracey Laboratories, Evanston, Illinois.

EXPENSIVE Chemicals, organic, inorganic, 15c quantities, 1000 items. Catalog free. Vaughn Chemical, Box 756, Berkeley, California.

CHEMICAL Analysis taught free by mail under my personal direction. Beginner's basic course (or brush-up) $1.00 brings complete chemicals for beginning and first lesson. J. H. Watters, Box 46, Bell, Calif.

LABORATORY chemicals and apparatus. New catalogue 10c. Luther Laboratories, New Britain, Connecticut.

LUMINOUS Paints will glow in dark. Six colors. Fairmount Chemical Co., 136 Liberty St., New York City 6.

NEW Idea Chemical and Apparatus Outfits for Home Experimenting, Photo-Scales, Microscopes, Chemicals, Biological and Laboratory Supplies in Small Quantities. Catalog 15c. Established 1931. John H. Winn, 124-B West 23rd Street, New York 11, N. Y.

61 HELP WANTED

INTERESTED in Latin American & Foreign Employment?????—$1.00 brings 1950 Copyrighted "Foreign Service Directory" World Wide Listings in Constructions; Oil, Mining; Aviation; Steamships; Manufacturers; Transportation; Exporters, Importers. Hot List Firms Hiring. How-When-Where to apply. Application form free. Global Reports, P. O. Box 883-S, Hollywood 28, Calif.

IMMEDIATE opening for 2 or 3 reliable men with car to call on farmers. No experience necessary. Steady work. $15 to $20 in a day. McNess Company, Dept. 265, Freeport, Ill.

POPULAR SCIENCE OPPORTUNITIES

ALASKA—Last Great American Frontier. $1.00 brings 1950 Copyrighted Directory & Government Map Free. Big Construction Projects; Fishing; Mining; Aviation; Hunting-Fishing-Game rules; Fur-Farming; Lumber; Live Stock; Agriculture; Homestead Land & Highway information. Listing firms hiring. Application form. Alaska Opportunist, P. O. Box 883-S, Hollywood 28, Calif.

$1 000 000 CONSTRUCTION Job-Project Report. $1.00 brings Monthly News Bulletin giving authentic projects starting "World Wide" USA; Alaska; Canada; Pacific; Arabia; Latin America; India; Mexico; Africa; Europe. Tells How-When-Where to apply. Global Reports, P. O. Box 883-PX, Hollywood 28, Calif.

MAKE $20 a day! Sell Staybright Brass Name Plates for front doors. Write Hubstamp, 357-F Congress, Boston, Mass.

JOB Opportunities. U. S. A. Vacancies: Construction, plants, offices, etc. Housing information. Free particulars. Business Services (AJ), Baldwinsville, N. Y.

FOREIGN Employment. Construction Men, Building Trades, Mechanics, Helpers, Office Men. Good workers interested in Foreign Development projects. Pipe Lines, Dams, power plants, Roadways, Shipping, oil Refineries, etc. Transportation and quarters furnished; High Wages. Listings of firms actively working on projects in Arabia, Persian Gulf, Africa, Alaska, Canada, South America, Europe, etc. Send $1.00 for Foreign Construction Compendium and Application forms. Foreign Service Bureau, Dept. PS-10, (Employment) P. O. Box 295, Metuchen, N. J.

FOREIGN Project Directory. $1.00. Foreign Service Institute, 1112 N.W. 18th Place, Miami, Florida.

FOREIGN Employment Information?? List of Overseas projects with Application Form: $1.00 (C.O.D. $1.32). Wentworth & Company, Box 3980, Miami, Florida.

62 AGENTS WANTED

EXCELLENT Sideline for printing and advertising salesmen. Decalcomania name plates in small quantities. Great demand. Also make money with our line of Automobile Initials and Sign Letters. Free Samples. "Ralco", XL-Roxbury, Boston 19, Mass.

CASH in on tremendous demand for new low priced burglar alarm for cars, homes and farm building. Nothing like it. Everybody wants one. 286% profit. Unique sample offer. Northwest Electric Co., Dept. 1-20, Pukwana, S. Dak.

WHERE To Buy 800 000 articles direct from Manufacturers. Save by buying direct. Sent Free. "Your Profits Under the Spotlight." Glass Pub. Co., Ellwood City 3, Pennsylvania.

DRESSES 18c; Coats $1.00; Blouses 35c; Free Catalog; Crown, 164-PB, Monroe St., New York 2.

GOOD Paying Business. Silvering mirrors, plating autoparts, reflectors, bicycles, bathroom fixtures, etc., by late method. No tanks or shop required, outfit furnished. Free Booklet. Gunmetal Co., Ave. C, Decatur, Illinois.

ANYONE can sell Hoover DuPont Nylon Uniforms for beauty shops, waitresses, doctors, nurses, others. In white and colors. Exclusive styles. Top quality. Low priced. Exceptional income. Real future. Equipment free. Write fully. Hoover, Dept. H-101, New York 11, N. Y.

1950 XMAS Card catalog ready! Earn more money as a wholesale jobber! Large selection of dollar box assortments. Imprints: Religious, Personalized, Christmas Cards! Three dollar sample boxes $1 Postpaid! Write for FREE Holiday Bulletin. Elfko, 438 North Wells, Chicago 10.

COMMERCIAL Deep Frying Course. Mock Chicken Legs, Potatoes, New and proven methods. Learn about this money-making field. $2.50 PP. Concession, Toledo 13, Ohio.

AT LAST! Something new and sensational in Christmas cards. Show gorgeous satins, velours and metallics never before offered. Gets easy orders fast! Pays up to 100% cash profit. Free Samples of 30 Christmas cards with name, 50 for $1.00 up. 80 Assortments. Personalized Book Matches and Stationery. Gift Items. 2 assortments on approval. Write Puro Co., 2861 Locust, Dept. 041-L, St. Louis, Mo.

NEW Jobs open in selling! Send name, address for five free issues of Opportunity Magazine's money-making guide, listing hundreds of companies who'll pay you well full or part-time. No experience needed. Opportunity, 28 E. Jackson, Dept. 18, Chicago 4, Illinois.

BIG Bargains for big profits. Over 100 sensational values. Men's used suits $2, pants 35c, topcoats $1.25, overcoats $2, shoes 20c. Experience unnecessary. Free wholesale catalog. Superior, 1250-B Jefferson, Chicago.

FREE Samples, and amazing plan, giving you Gorgeous Dress without penny cost. Rush name today with dress size. Harford, Dept. C-335, Cincinnati 25, Ohio.

SCHOOL Seniors!!! Your postal will bring our wonder, Kwick-Sell Cardalog of popular Graduation Name Cards. Biggest profits!!! Only firm giving free souvenir chest and Card Case. Don't miss out! Hurry that postal!!! Craftcards, Box 235 (M), Pittsburgh 30, Pennsylvania.

BRAND New! Amazingly different and smart Christmas Cards bring you big money! Take easy orders for sensational new Christmas Cards. Pays up to 100% cash profit. Christmas Cards With Name 50 for $1, up. Big Line Personal Stationery and Book Matches. Get sample assortments on approval. Imprints Free. Write today. North Star, Glenwood, Dept. M-19, Minneapolis, Minn.

SELL America's only $1.00 Gift wrap assortment containing 30 full size sheets; Giant plastic pencil containing personalized pencils; Santa stocking with name; Rudolph, the red nosed reindeer assortment. Over 100 Christmas card box assortments and surprise items. Write today for free portfolios of personalized Christmas Cards. Elmcraft, Dept. 17, 5930 S. Western, Chicago 36.

SELL new clothing. Lowest prices. Operate from home, auto, store. Enormous Profits. Big catalog free. S & N, 565-AB Roosevelt, Chicago 7.

NEW Eyeglass Polisher. Amazing polishing cloth stops fogging, blurring. Cleans glasses beautifully. Samples sent on trial. Kristee 156, Akron, Ohio.

NEW Way To Make Money! Sell Ladies' Rain Sandals to friends, others. Includes FREE carrying pouch. Spectacular $1.00 seller. Amazing profits. Write for sample on approval and money-making details on complete line Christmas, Everyday Greeting cards, Novelties. Experience unnecessary. Bargain Offers. Hedenkamp, Dept. PS-44, 361 Broadway, New York.

$1.00 STARTS you in business. Sell men's neckwear full or part time. Low investment, big profits. Send $1.00 receive sample tie. Free color catalogue, selling plan, wholesale price list. Radio City Neckwear, Dept. PS-6, 112 W. 50th, N. Y. C. 19.

SHINE Shoes Without "Polish." New invention. Lightning seller. Shoes gleam like mirror. Samples sent on trial. Kristee 157, Akron, Ohio.

FREE sample nylon stocking of world's only nationally advertised hosiery line actually guaranteed against runs, snags or excessive wear, regardless of cause! It's amazing but true. Every weight from sheerest 15 denier to heavy 70 denier—all gauges to luxury 60 gauge. Amazingly low prices, starting at $1.08 prepaid for sheerest 15 denier 51 gauge. Not sold in stores. Good Housekeeping Guarantee Seal. Also complete line men's hosiery guaranteed one full year or replaced free. Full variety lingerie in crepe, satin and nylon, featuring all nylon slip at $2.95, satin slip at $1.58, etc. Housecoats and robes. Kendex sales people will earn one million dollars this year. Get your share. No money or experience needed. Pay nothing now or later. Just show free outfits. Write orders. We deliver and collect. Advance cash plus huge bonus. Earn money spare or full time. Become manager—appoint others to sell for you—earn steady income on their sales. Man or woman—young or old, you can earn more money than you ever thought possible. Everything you need is furnished free and prepaid, including nylon stocking, samples of materials, sales books, 36-page salesmanual, color cards, etc. Simply write your name and address on postcard and mail to Kendex Corporation, Babylon 74, N. Y.

FAST profits—No investment. Send for big, free catalog. Plastic aprons, tablecloths, etc. 150 sure-fire items. We guarantee sales. Write The Halliday Co., Dept. P-10, 15-19 Pennington Ave., Passaic, N. J.

START Your Own Business on credit. Always your own boss. 1559 Dealers sold $5,000 to $28,000 in 1949; their average $6,834. We supply stocks, equipment on credit, 200 home necessities. Selling experience unnecessary to start. Wonderful opportunity to own pleasant profitable business backed by world-wide industry. Write Rawleigh's, Dept. J-U-PSC, Freeport, Ill.

SELL DuPont Nylon Uniforms. Complete line famous exclusive Hoover Styled nylon uniforms for beauty shops, nurses, doctors, waitresses, others. Best quality, splendid values. Exceptional income. Real future. Equipment free. Write fully. Hoover, Dept. J-101, New York 11, N. Y.

MEXICAN feather pictures. Sell on sight; 200% profit! Free details; sample 10c stamps. Sylvia-SG, Apartado 9036, Mexico City.

PERFUME—Sideline to Independence. Learn. All—Free—"International". 6347 Parnell, PS-10, Chicago 21, Illinois.

ADD To Your Income. Excellent Profit Selling Otamic Wonder Paste To Homes, Restaurants, Service Stations For Cleaning Painted, Enameled, Porcelain Surfaces. Works like Magic. Quart sample, Literature 65 cents. William Morris Associates, 108 Dunlap, Northville, Michigan.

SELL S-C Cigarette Snuffer Trays, good profits. Southern Cities Co., 1025 Security Bldg., Long Beach 2, California.

PHOTO-Salesmen-Agents. Sell beautiful hand colored plastic enlargements and sensational new photo compacts, rings, bracelets, lockets, etc. Collect deposit, we deliver. Profitable sideline. Send card for Free sample kit. Novel Portrait Co., 3342-A North Ave., Chicago, Ill.

GOLD lacquered Window Sign Letters. Large Sizes. Penny Each. New foils. Absolutely Beautiful. Free Samples. Atlas, 544 W. 79th, Chicago 20.

EARN Big Money taking orders for attractive Boxes of Xmas Cards. 50 for $1.00 up. Also Metallics, Plastics, Wraps, Children's Cards & Books, Name-On Stationery, Napkins, etc. Samples on Approval. Call, write or phone Rainbow Greeting Cards, 38-R E. 1st St., New York 3.

FREE SAMPLES. Big profits showing amazing Glow-in-the-Dark specialties. House numbers, pictures, plastic novelties, ashtrays, keyholders, religious and nursery objects, etc. Madison Plastics, 303 Fourth Ave., New York 10, N. Y.

SELL Ultra-blue stock signs to stores. 1000 slogans, comedy, general religious. 7" x 11" cost 6c, sells 35c. Make money. 15 samples $1.00 postpaid. Lowy, 812 Broadway, Dept. 560, New York.

AGENTS—Big Line Including Food Products. Fast selling premium and bargain deals. Low prices. Send card for big outfit offer with gift. Ho-Ro-Co., 2771 Dodier, St. Louis 7, Mo.

AMAZING offer—$40 is yours for selling only 50 boxes Christmas cards. And this can be done in a single day. Free samples. Other leading boxes on approval. Many surprise items. No experience needed. Free samples personalized Christmas cards, stationery, napkins. Write today. It costs nothing to try. Cheerful Card Co., 1689 White Plains, N. Y.

NYLON, Poplin, Rayon Uniforms, white and colors. Immediate Delivery. Immediate Profits. Sell to Doctors, Dentists, Nurses, Waitresses, Beauticians, Housewives. Free Sales Kit. Superior Fabrics, Dept. A-1, 3936 Market St., Phila. 4, Pa.

SELL Big Money-Maker to Men and Women. Easy handwork makes fast-selling useful articles. Sample free. Sunmade Company, Brockton 64, Mass.

JEWELRY For Salesmen. Distributors Direct Factory. Catalog Free. Pickcraft Co., 194 Bank St., Attleboro, Mass.

POWER Mower—$45.00 net. Delivered. Sensation. War "boom" demand. Rotacut, R-2000, Excelsior Springs, Mo.

SELL gold embossed Christmas Cards, napkins, matches, coasters. 50 for $1 imprints. Samples free. Dunbar, New Brunswick 21, New Jersey.

$1 STARTS you in business. Sell fine $1 ties, $1.50 and up values only $7.20 dozen, you make $4.80. Send only $1 for 2 sample ties. Catalog free. Philip's Neckwear, Dept. P-44, 20 West 22nd Street, New York 10.

IS $210 a week worth a penny postcard to you? Then rush card with name and address for special Free Trial Plan that sells amazing new Automatic Refrigerator Defroster "like hot cakes!" Write to Mr. Lewis, D-Frost-O-Matic Corp., Dept. PSC-10, 6 N. Michigan, Chicago 2, Ill.

BUY thousands of nationally advertised products direct from manufacturers and distributors. Write for "Buy Direct and Save." Service Publishing, 1420-B Investment Bldg., Pittsburgh 22, Pa.

$184.00 CONTINUOUS Profit from every $8.00 investment. Shampoo powders in bulk. Bottle yourself or sell powders. Request Convincing facts. Morael Manufacturing Company, 505-M Fifth Ave., New York City 17.

THERE'S big money taking orders: Personal Initialed Buckles with Belts, Tie Holders, choice of over 3,000 Emblems, Cap and Breast Badges for every purpose. Uniforms, Work Clothes. Embroidered with company name, trademark, sales message, etc. Prospects everywhere. Latest styles, finest fabrics. Write for selling kit. Hook-Fast Co., Box 480PS, Roanoke, Va.

BEST Sellers in quality plastic tablecloths, aprons, garment bags, utility covers. Free catalogue C110. Acclaim Products, 49 West 24th Street, New York 10, N. Y.

CHRISTMAS Cards, Personalized Gift Items. Raum, 4154-B Fifth Street, Philadelphia 40.

ADVERTISING book matches—Cash in on big demand—sell Union Label matches. Cuts for all businesses and political parties—Free powerhouse selling kit—low prices—protection guaranteed on repeat orders—Cash commissions. Superior Match Co., Dept. P-950, 7530 Greenwood, Chicago.

$250 WEEK reported! Free illustrated book "505 Odd Successful Businesses." Work home! Expect something odd! Pacific-E, Oceanside, California.

CALENDARS and Advertising Novelties. All sizes, styles and prices, including Household, Religious, 12 Sheet, Girls, Pencils, Rulers, Key Chains, Thermometers, etc. Fleming Calendar Co., 6539 Cottage Grove, Chicago 37, Illinois.

FREE Literature—Thousands Wholesale supply sources. Moneymaking Business ideas. Wilkin Company, Hillsboro 2, Ohio.

SELL the fastest money maker out! Handy Hannah automatic wax dispenser pays you over 100%. Every housewife wants it. Saves time . . . labor . . . stooping . . . mess . . . waste. Press button and wax is released. Sample and details write Everett Young Co., Whitman, Mass.

PROFITABLE spare or full time selling "NuSilver Polish and Plating Liquid (cloth applied) Products." NuSilver, 508-PS10 NY St., Aurora, Illinois.

SELL! Balloons, Combs, Specialty Merchandise. Carleton House Distributors, Texas City, Texas.

FREE Samples. Famous Desk Signs, House Nameplates. Whitney's 94 Beulevard, West Springfield, Mass.

FREE Outfit! Write today! Sell Embroidered Advertising Uniforms and Work Clothes. Initial Buckles, Belts, Badges, 2000 Emblems. Hookfast Co., Box 480PS, Roanoke, Virginia.

WRITE for free booklet and catalog telling how to earn substantial profits in your spare time by forwarding new and renewal subscriptions to all magazines for your friends and neighbors. Oldest U. S. Agency. Established 1869. Moore-Cottrell, North Cohocton, New York.

AGENTS—300% profit selling genuine gold window letters; stores and offices. Free samples. Metallic Letter Co., 437 N. Clark, Chicago.

63 HIGHGRADE SALESMEN

SALESMEN—Sell America's finest, biggest line of Advertising Specialties. Sensational sellers to all types of business. Big Commissions Advanced. Sensational sales plan nets you top earnings. Free Outfit. Charms & Cain, 407-SP South Dearborn, Chicago 5, Illinois.

I'LL Send You A Fine Suit and start you in a Big Money Business in your home or office. Get your made-to-measure suit without cost taking orders at direct-from-factory prices. Big commissions. Splendid outfit with samples. Tested plans. Top men make up to $9,000 in a year. Write Manager, Dept. 28, Box 23, Cincinnati 6, Ohio.

SALESMEN—Put yourself in line for big money, real future. Keep stores supplied with 5c-10c to $1 counter goods. Nationally advertised. Top profits for you and merchants. Liberal deals boost sales. Sideline or full time. World's Products, Dept. 83-M, Spencer, Ind.

SALESMEN. Earn $50.00 weekly, selling only three pairs shoes daily. Commission and bonus. Wide variety for men, women, children. No investment. Experience unnecessary. Free catalog. Tanners Shoes, 666 Boston, Mass.

BIG Money Taking Orders; shirts, ties, sox, pants, jackets, sweaters, shoes, uniforms, etc. Sales equipment free. Experience unnecessary. Nimrod, 4922-EK Lincoln, Chicago.

EARN More with New Family Insurance—pays for disability, death, retirement. Costs only $1.00 month. Reliance, Phoenix 6, Arizona.

SALESMAN—Sell Fur Coats. Good quality coats as low as $29. Sell from our illustrated booklet. Experience unnecessary. Season now starting. Free Booklet. M. Seidel & Son, 2067-82nd St., Brooklyn 14, New York.

IMMEDIATE Earnings As Factory Salesmen . . . Build your own permanent year-round Repeat business . . . Sell patented Air Cushion Shoes. Not available in stores. Complete Family & Work Line. Dignified work calling at business places. Full time or side-line. Advance Commissions up to $25.00 per day. Free Outfit. Chas. Chester Shoe Co., 70 Foundry St., Brockton, Massachusetts.

AD Matches! Sell Amazing Designs—20, 30, 40 and 240-light book matches. Big spot cash commissions; every business a prospect. Low prices for high quality. Repeats. Start without experience; men, women; full, part time. Buy Nothing! Sales kit furnished. Match Corp., Dept. PS-10, Chicago 32, Illinois.

LOOK Here! Wanted—Men and women to start in business on credit. Sell some 200 farm-home Products. Thousands of our Dealers now make quick sales, big profits. For particulars write Rawleigh's, Dept. G-192-PSC, Freeport, Illinois.

67 EDUCATIONAL AND INSTRUCTION

PIANO Tuning Pays. Learn this profitable profession at home. Our Tonometer and mechanical aids make learning easy. No knowledge music necessary. Diploma granted. Largest and oldest school—51st year. G. I. Approved. Write for booklet. Niles Bryant School, 77 Bryant Bldg., Washington 16, D. C.

GUNSMITHING—learn for profit, pleasure! Practical Residence Course, day or eve. G.I. approved. Limited enrollment. Facts free! Pennsylvania Gunsmith School, 423 Federal, Pittsburgh.

WORK For U. S. Government! Start high as $66.34 week. Men-Women. Qualify Now for secure positions. Many openings expected soon. Don't delay. Free 40-page book shows jobs, salaries, sample tests. Write: Franklin Institute, Dept. K-22, Rochester, New York.

AIRBRUSH Photo Retouching Simplified. 104 pages, $2.00 postpaid. Harold Green, 117-F East 60 St., N. Y., N. Y.

FOOT Correctionists: — Protect your rights. Join: American Pedopractic Association. (Details, $1.) 235-S Brevard, Charlotte 6, N. C. Courses offered also.

SEE our collection-credit business ad under Business Opportunities. Cole and Associates, Syracuse, N. Y.

BOOKKEEPERS! Increase your earnings! Operate your own simplified "Dollar-A-Week" Bookkeeping and Tax Service. Full or spare time. Details Free. No obligation. Ellis, Box 203, Cedar Grove, North Carolina.

BECOME a Doctor of Psychology or Metaphysics. Teach secret of contentment, happiness. Win degree of PsD, or MsD. Solve mental worries. Free book. College of Universal Truth, 5153-K N. Clark, Chicago.

MEDICAL Laboratory Technicians in great demand. We train you in your own home. Catalogue free. Imperial Technical Institute, Box 973-B, Austin, Texas.

WORRY, tension and fears knocked out or no cost. Free brochure and details. Write President Ballard, 10th floor, Washington Bldg., Louisville 2, Ky.

MASTER Salesmanship on phonograph records. To succeed, you must be a salesman—all your life (regardless of your work). Detroit Sales Executives Club says "Each recording is a classic!" Cost is trifling—results are tremendous. Write for descriptive literature. Parker Institute, 1028 South Saginaw, Flint 3, Michigan.

SELF-HYPNOSIS. Infallible method! $1.00. Hampton, 3121 Hamilton Way, Los Angeles 26, California.

LEARN Gunsmithing! Details. Copy "Guns and Gunsmithing," 25c. Gunsmith's Supply, Palatine 6, Illinois.

AMAZING new scientific way to remember. Free details. H. Kave, P. O. Box 261, Staten Island 1, New York.

READ With Speed! New Amazing Method! Save hundreds of hours yearly. Free test. Speed-Reading, 9111-B Hoyne, Chicago 20.

GET photographic mind with Supermemory. Write Thor Books, S-9 Box 1210, Chicago.

USED Correspondence Courses and Educational Books Bought, Sold, Rented. Catalog Free. Educational Exchange, Summerville, Ga.

FIX Typewriters full or part time. Prepare yourself for profitable future. Our Home-study course trains you with drawings and photo illustrations. Write Typewriter Training, Corbet Building, Tarentum, Pennsylvania.

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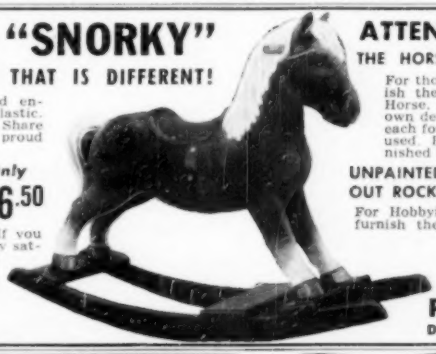

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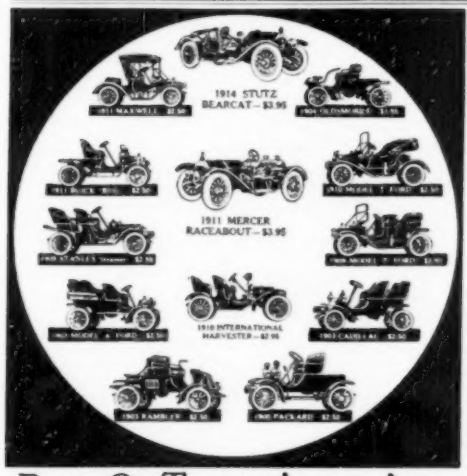

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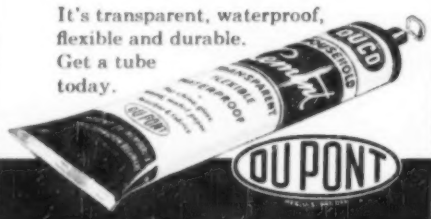

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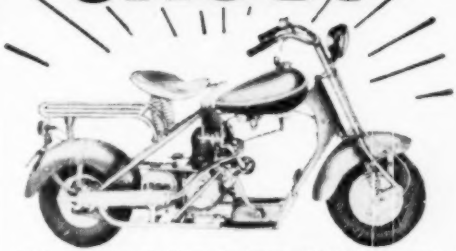

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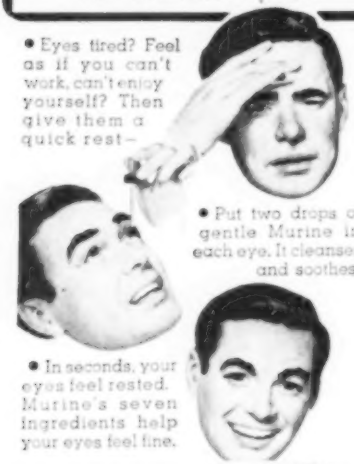

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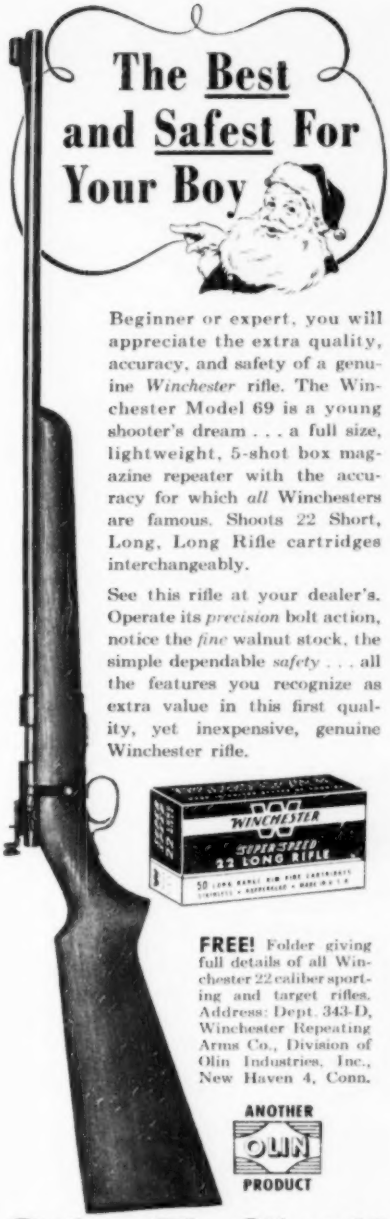

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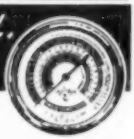

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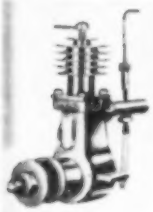

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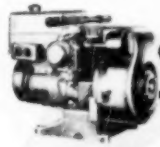

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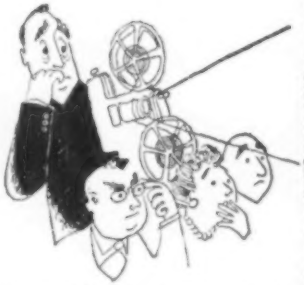

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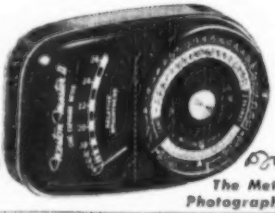

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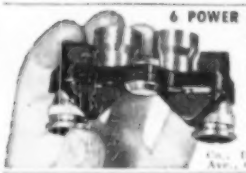

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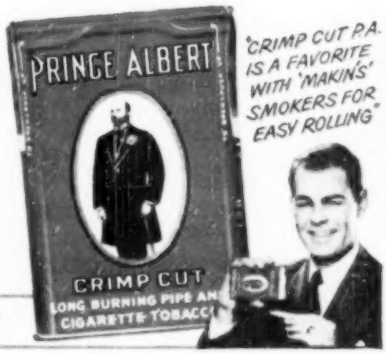
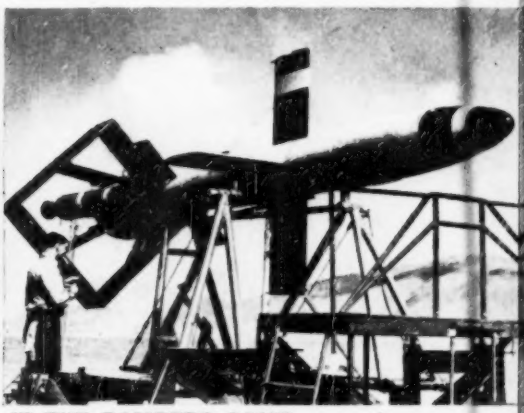


THE NATIONAL JOY SMOKE

Popular Science *Highlights* this Month

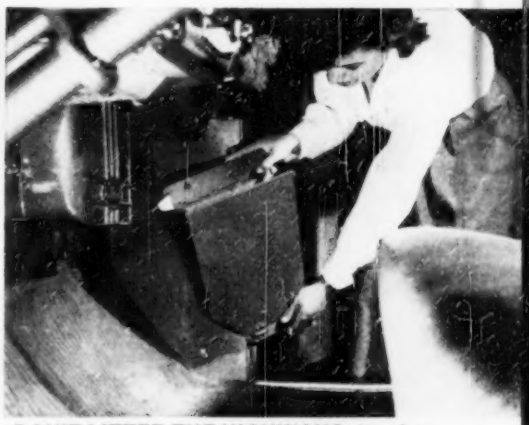
BUILD YOUR OWN DESK: It isn't hard when you use inexpensive shiplap lumber and follow these simple directions. **Page 186**

AMERICA'S MR. AUTOMOBILE, Wilbur Shaw, checks notes after testing the '51 Nashes. Read *Report from Driver's Seat.* **Page 105**



IF THE BOMBERS COME, a near-human rocket with radar eyes and electronic brain could be our close-in defense. **Page 124**

FLY THE UN FLAG: Here are simple instructions for making the flag that flies over the armed forces at Korea. **Page 197**



DON'T LITTER THE HIGHWAYS: Put those candy-bar wrappers and other trash in this handy, easy-to-make auto wastebasket. **Page 195**

New GI Weapons

Korea showed us how the Infantry can use its new tools to multiply manpower into deadly firepower

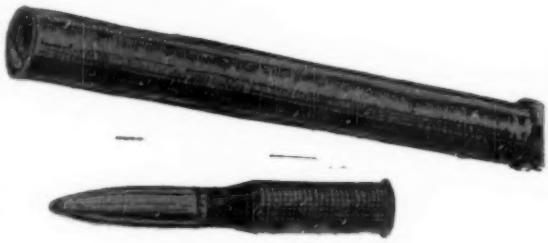
Bazooka team armed with new 3.5-inch model lies in wait for Red tank somewhere in Korea. Extra round of potent shaped-charge rocket ammunition lies ready for second shot.

By John F. Loosbrock

DRAWINGS BY RAY PIOCH

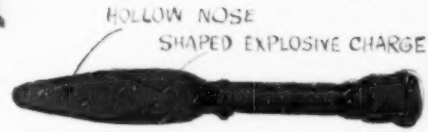
THE big lesson of the "little war" was that fighting was back to fundamentals—men against men on the ground. And men against metal—the armor of enemy tanks and the killing fragments of enemy shells, bombs, and bullets.

Weapons, along with training, make the difference between sheer manpower and total killing power. The guy doing the shooting and catching the incoming mail in Korea, soon came to rely most on the tools he could carry. The small arms, machine guns, bazookas, mortars, and recoilless cannon, which can move with the troops,



Infantry's hand artillery is recoilless rifle, 75-mm. model of which is shown above. Kickless action comes from use of perforated shell case and breech arrangement that vents recoil gases. High-explosive ammunition is fired against enemy troops. Shaped-charged shell like bazooka's may soon make it useful against tanks. Weighing only 115 lb., it is usually fired from heavy machine-gun tripod and can be mounted on jeeps. It also comes in 57-mm. size.

Super-bazooka weighs only 15 lb. and comes apart for easy carrying. It has bipod for steadiness, optical sight with rubber eyepiece for accuracy. It's triggered by magneto firing mechanism concealed in handgrip. Weapon has no recoil since it's merely hollow tube firing 8½-lb. rockets. Secret of effectiveness is shaped charge illustrated at right.



Cutaway above shows shaped charge.

When shell hits armor plate, cone focuses force, blowing hole in steel.

Tanks, artillery, and air support were dandy—weather and other conditions permitting. But the footsloggers needed most the stuff they could lug and fire themselves.

Biggest news for the embattled doughfoot was the dramatic introduction of the super-bazooka. It was disheartening to watch Red tanks keep grinding along after direct hits with the old 2.36-inch job. The new 3.5-inch bazooka had been blueprinted and range-tested long since (PS, July, '49, p. 96). But it had to be snatched from the pigeonhole of "economy," rushed through the arsenal, and flown to the fighting front in record time.

And out where the tanks weren't ours, the super-bazooka quickly came through. Its 8½-lb. shell can slam through 11 inches of tough armor. Such shocking power comes from a hollow explosive head that utilizes the so-called "Munroe effect," first described by Prof. Charles E. Munroe 50 years ago in this magazine. (PS, Feb. 1900, p. 144 and Feb. 1945, p. 65).

With the super-bazooka, the foot soldier has a potent new weapon he can carry on his back and shoot from his shoulder. But it has its drawbacks. It's strictly a one-shot job that takes guts as well as gunpowder. It can kill tanks—big tanks—but only when you're so close the tanks can kill you, too.

That's why some would like a repeating bazooka that you can hold on the target while firing. Maybe a double-barreled job, like a shotgun. Then, if your first round is short or over, you can correct the error with the second.

The other big bang against tanks is the recoilless rifle. This is literally hand artillery that the GI can carry right up with his rifles and machine guns. Right now, it comes in 57-mm. and 75-mm. sizes, but bigger kickless cannon are in the mill. A 90-mm. would seem the obvious next step, maybe even a

.45-cal. pistol. Defensive handgun good only under 100 yd. Holds 7 rounds, can knock down a man hit anywhere.

Carbine. Now modified to fire fully automatic like Tommy gun. Fires .30-cal. bullets from 30-round clip.

M1 rifle. Basic Infantry weapon. Gas-operated, semiautomatic. Weighs 9½ lb. Clip holds eight .30-cal. rounds.

Submachine gun. War-developed "grease gun" has folding stock, weighs only 8 lb. Fires .45-cal. ammo from 30-round clip.

Browning automatic rifle fires its 20 rounds of .30-cal. bullets in a burst of from 2 to 4 seconds.

Light machine gun. Weighs only 32 lb., fires .30-cal. ammo from belt at 400-500 rounds per minute.

Heavy machine gun. Defensive version of light gun. Water jacket cools barrel, allows faster firing (450-600 rounds of .30-cal. per minute).

105-mm.—although that's getting pretty big for manhandling without wheels.

The principle of the recoilless rifle is simple. When you shoot a .22 the physical action and reaction lets you push a little piece of lead a mile by absorbing the same amount of push with your shoulder. That's the recoil. Whatever power blows the bullet out of the gun also blows the gun back. So in the big sizes, conventional cannon need a lot of weight to soak it up.

The kickless cannon solves the problem by firing both ways. The charge is in a perforated shell case lined with paper. When you fire, the fast-burning powder simultaneously kicks out the projectile and bursts through the perforated case. The recoil gases are vented through an ingenious breech system.

The recoilless rifle shoots straighter and farther than the bazooka, but it has its disadvantages, too. The same arrangement that eliminates recoil cuts down muzzle velocity. Worst of all, it has a terrific backblast that throws a sheet of flame at night, a cloud of dust by day. The men who shoot it can't linger in a good emplacement. A couple of shots and they move—but quick. Recoilless riflemen, like bazooka-men, need cover behind them as well as in front.

Another big piece of news in the private war of doughfoot vs. tank is a military marriage—a new 90-mm. shell that weds the devastating shaped charge of the bazooka with the range and accuracy of the rifle.

The Army has used a shaped charge in its 105-mm. artillery shells for some time. But it is no secret that the Munroe effect doesn't Munroe so well when spinning. It gets its killing power from the careful balance of forces focused by its hollow cone. Like focusing the sun's rays with a lens, it has to be done just right to work.

Apparently, the new 90-mm. shaped-charge shell takes full advantage of the accuracy-imparting rifled spin while getting out to the target. Then it's stabilized in flight by pop-out fins. At what point the

shell stops spinning has not been disclosed. But for maximum effect, it should be as close to the target as possible. Maybe a VT-type proximity fuze to make the fins pop out at just the right distance could be the ultimate answer.

In any event, a shaped-charge shell, fired from a rifled barrel, with fins to stop its rotation, is good news. Given the same projectile for his recoilless rifles, GI Joe may soon get into his hands his personal answer to even a Joe Stalin III tank.

When that day comes, the men who have ignored, neglected, or evaded the development of a U. S. tank fit to tangle with a Stalin will have their justification. Only then can come what Secretary of the Army Frank Pace probably had in mind when he told West Pointers shortly before the "little war" that "tank warfare as we have known it may well become obsolete."

And the prophecy of Vannevar Bush, who, in his book *Modern Arms and Free Men*, called for the marriage of the bazooka and the recoilless rifle, saying "a tank wandering through country infested with such weapons would have a short life," would become a reality.

The footslogger can then concentrate on knocking out manpower with firepower: flinging metal against flesh rather than men against men.

The bazooka and the recoilless rifle—and their eventual offspring—are the new tools of the foot soldiers of a nation that traditionally has preferred to sacrifice machines rather than men. But the Infantryman still has many old reliables in his bag of weapons—old reliables with new tricks.

The problem of all war on foot—and wars either begin or end with bodies in shoes—is to increase firepower without straining the back of manpower. One way is with a new rifle, enough lighter than the present M1 (Garand) to let a man carry more (and maybe lighter) ammunition.

Such a weapon—and we have one under close security wraps—would have to be more

Hand grenade. Fragmentation type shown. Serrated iron case explodes into slugs.

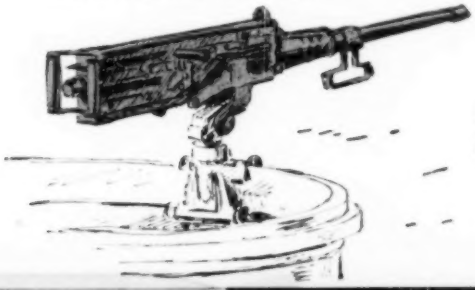
Rifle grenade. Antitank type. Fired with blank cartridge from launcher clamped to rifle barrel. Has shaped-charge head.

60-mm. mortar. Has smooth-bore tube, down which ammo is dropped on firing pin. Tosses 3½-lb. shell a mile.

81-mm. mortar. Big brother of 60 mm. Shoots two sizes of high-explosive ammo plus white phosphorous smoke shells. Also a smooth-bore, it has range of almost two miles. Weight is around 135 lbs.

4.2-inch mortar. Originally developed to hurl chemical shells, has been appropriated by Infantry for high explosive. Can toss 25-lb. shell more than 2½ miles.

.50 cal. machine gun. Now used only for anti-aircraft protection of vehicles.



Bayonet. Still issued—the Infantryman's can opener and sidearm.

than self-loading. It would have to be automatic, able to fire in bursts as well as single-shot. It would need a cutaway stock, and the best metallurgical know-how to whittle away weight. It would be to the gas-operated M1 as that was to the bolt-operated Springfield. And it might replace a whole family of light weapons.

Like the carbine. That baby rifle has already been modified to fire fully automatic from a 30-round clip. It has displaced the pistol for officers and men except for those whose duties require them to carry the purely defensive, Model 1911, handgun. And for them a lighter pistol is in the works.

It might well replace the submachine gun, so useful in street and jungle fighting. Here the original Thompson has given way to the World War II "grease-gun" that spits 350-450 snubby .45s a minute.

And the BAR (Browning Automatic Rifle), firing the same .30-cal. cartridge as the M1, but fully automatic at from 5 to 10 shots a second. A hero of two wars, this heaviest (16 lb.) of shoulder arms would be the first to bow before a new basic rifle.

Machine Guns Hold Their Own

Machine guns haven't changed much although again a new lightweight model is in the works. Each rifle squad has a light Browning, caliber .30. It has a shoulder stock and bipod, is air-cooled, fires 400-500 rounds a minute. Its heavier brother is essentially the same gun, water-cooled for sustained firing, with a tripod for accuracy. The old .50 caliber, *an antitank gun in 1940*, has been relegated to an antiaircraft role to protect vehicles.

Rifle grenades, and their little brothers for the carbine, are pocket-bazookas. They fire either a shaped or fragmentation charge, using a launcher that fits over the end of the barrel and a special cartridge. A new added cartridge in the launcher gives extra range.

Hand grenades come in two brands—fragmentation, which explodes into chunks of killing metal; and concussion, which stuns by blast for close-in fighting.

Finally comes the mortars, which make a soft "chug" when fired in their high arcs and a deadly "baloomph" when they land. They range from the toylike 60-mm. tubes that can lob a 3½-lb. shell a mile, through the 81-mm. jobs, to big 4.2-inch rifled models that toss a 25-lb. shell over 2½ miles.

These king-size mortars were originally developed by the Chemical Corps to fling white phosphorus and liquid gas-filled shells, but the Infantry grabbed them for added duty. They work so well throwing high-explosive stuff that even larger mortars are likely. The only limitation on size seems to be the ingenuity with which they can be broken down into easily handled pieces.

These, then, are our tools of ground warfare.. Their trend toward increased firepower points up a battle-learned lesson—that in combat only a fraction of individual riflemen actually fired their weapons.

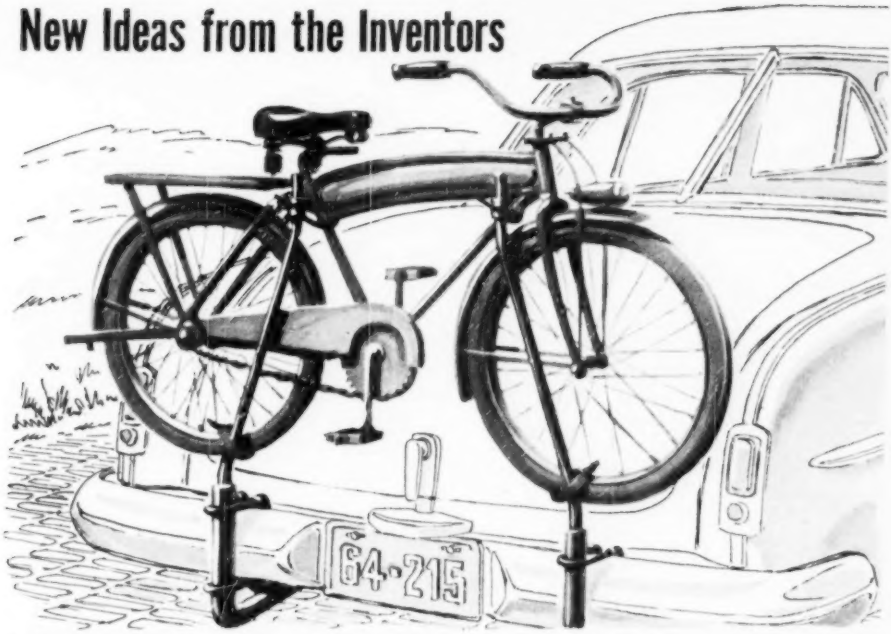
So it is significant that the brightest flashes in the Infantry's new firepower are team weapons like the bazooka, recoilless rifle, and mortars. That's what will pitch the most metal against the most men. END

My Most Ingenious Solution

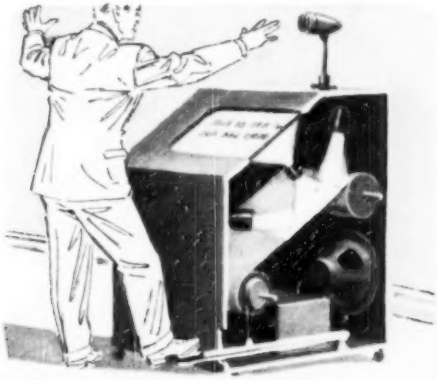
Our hot-air furnace has two long, horizontal ducts leading to the two rooms farthest from the furnace. These two rooms are hard to heat, rarely getting any warm air. Instead of installing permanent fans in the ducts, I warmed the rooms by hooking up a simple appliance that you'll find in almost every home. What did I do?

In the back of the furnace is an opening through which cold air enters to be heated and distributed. I placed an 8" electric fan so it blew into the opening. Within a few minutes warm air started to flow into the two cold rooms and continued even after the fan was turned off. The initial load of cold air in the long ducts couldn't be displaced because of the lack of rise in the ducts. The little fan forced the warm air into the ducts and started the chimney effect that continued, even after the fan was shut off.—G. Walton, Sharonville, Ohio.

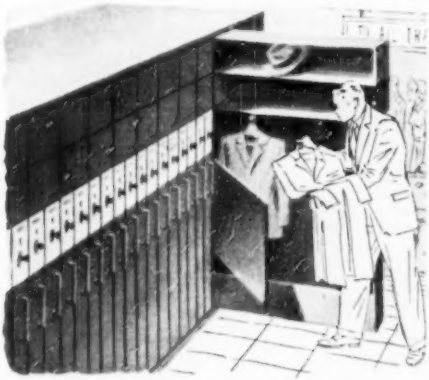
New Ideas from the Inventors



1 Bumper Rack to Hold Bicycle. The problem of how to carry Junior's bike on trips is solved by this easily installed carrier. The two standards that form the rack are simply inserted in sockets in the base members, which also double as bumper guards. The bicycle frame rests on rubber-covered arms and is held in place with padded chains. Straps on the lower part of the standards hold the wheels.



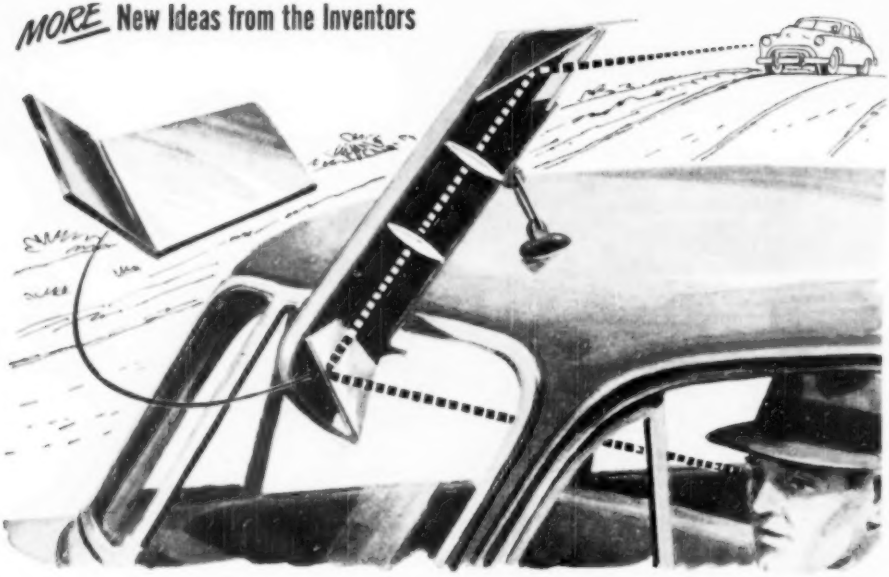
2 Speaker Stand to Project Notes. There would be no fumbling with notes if this speaker's stand were used. The notes, typed on a roll of paper, are projected on a translucent screen that forms the stand's top. A foot-operated pedal turns the roll to advance the notes as desired. Stand also has its own public-address system.



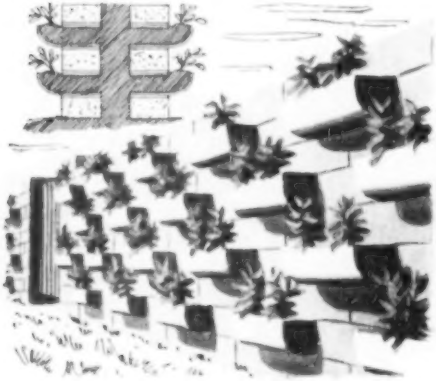
3 Coin-In-Slot Clothes Lockers. Designed for use in restaurants, theaters, and similar public places, these coin-operated lockers simplify the problem of checking hats and coats. The tall, narrow lockers pull out from the front, then the clothes are put in from the side. A coin must be inserted before a cabinet can be locked.

Turn the page, please, for three more new ideas.

MORE New Ideas from the Inventors



4 Rear-View 'Scope for Cars. A better rear view for car drivers is claimed for this periscope that is mounted on the windshield and secured to the vehicle's top by means of suction cups. It has an inclined pick-up mirror, two lenses, and twin viewing mirrors arranged in the form of a V to avoid a reversed mirror image. This gives a magnified horizontal field of view of better than 90 degrees.



5 Wall Bricks to Hold Plants. Strawberry, cucumber, tomato, and other plants can be grown in the walls surrounding gardens and lawns if this "flowerpot" brick is used. Hollow and made large enough to extend beyond the face of the wall, the bricks would hold sufficient dirt to nourish the growth of plants.

6 To Cook Bacon Flat. This kitchen aid is designed to prevent bacon from curling while it is being cooked. A large, circular, weighted spatula with a handle, it holds the bacon strips firmly against the bottom of the frying pan and keeps them flat. The bacon cooks through evenly without having to be turned.

Patents on these inventions have been granted to: 1. E. Donnelley, Lake Forest, Ill.; 2. F. Collins, Des Plaines, Ill.; 3. E. Davis, Newton Center, Mass.; 4. J. Delaney, Los Angeles, Calif.; 5. R. Cain, Spartanburg, S. C.; 6. C. Barnes, Philadelphia.

When the Nash Statesman (left) and Ambassador (right) for 1951 were brought to the Speedway for my Report from the Driver's Seat, I discovered their lines had been slicked up, grille redesigned with convex instead of concave bars. With me is Devon Francis, of the POPULAR SCIENCE editorial staff. In background is pagoda that houses officials on race days.

Shaw Gives New Nashes a Speedway Workout

By Wilbur Shaw

PS PHOTOS BY W. W. MORRIS
ON LOCATION AT THE INDIANAPOLIS SPEEDWAY

EDITOR'S NOTE: *For another Report from the Driver's Seat, Wilbur Shaw, America's best-known man behind the wheel, moves to home ground, the Indianapolis Speedway, of which he is the boss. This time he invites you to ride with him in the '51 Nashes.*

NOW I can tell you that the new Nash Statesman and Ambassador for 1951 had a sneak preview right in my own back yard—the Indianapolis Motor Speedway—weeks before the public announcement a few days ago. They had been smuggled out of Kenosha, Wis., in a covered trailer. The idea was for me to give them the business on my home grounds.

When I first saw the new Ambassador it had two men in it—sound asleep. They had rolled their trailer into town at 4 a.m., too

My son Bill, who is 5, wanted to get into the act. Here he demonstrates the importance of a Nash pioneering safety move. A sudden stop or collision could throw him into the windshield. So a safety belt is being built into these seats to protect the passenger.

late to check into a hotel and still be on hand in the morning when I was scheduled to arrive at the track. So they simply made up the beds in the car and turned in.

Nash is the only car made in the U.S. with such beds. And they're handy, I can tell you, for those long cross-country drives.

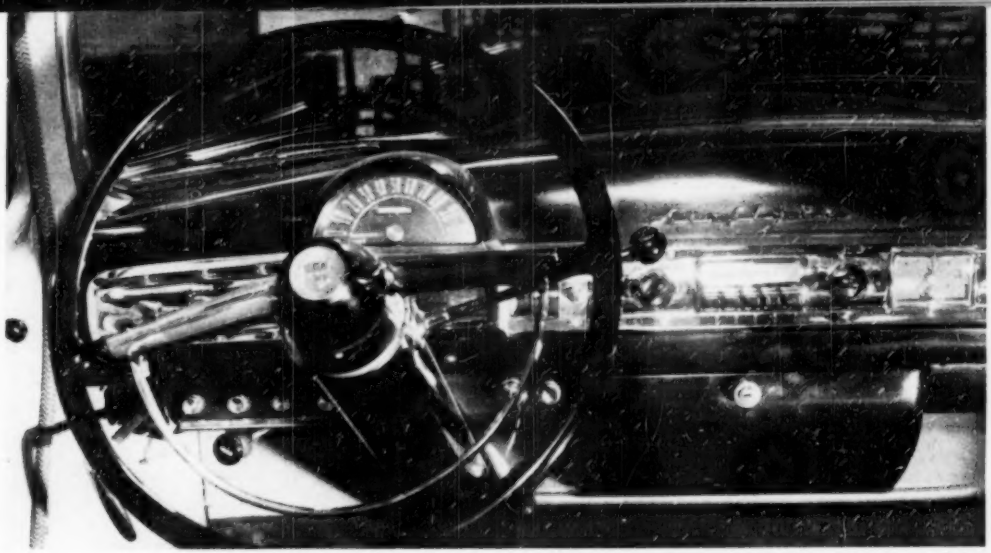
Driving the new Nashes, we were both on familiar ground. It was a Nash that paced the "500" in 1947—zipping around the track for that first lap ahead of the field of racing cars. This track, of course, has been famous since 1911 as a difficult course for automobiles. The turns are fairly flat, and if a car has any bad skittering qualities, they'll come out here.

First I took a quick turn around the track in each of the cars for an initial feel-out. Then I settled myself behind the wheel of the Statesman to see what she really would do. This car had a conventional gearshift. I had my recording set alongside me on the seat to get a running record of my impressions, just as I did when I drove the new Packards for the article in last month's POPULAR SCIENCE. Here's the start of the playback from the recording:

The instrument panel has been improved. They've taken their Uniscope . . . that's a combination of all the important instruments under one glass face . . . they've taken that off the steering column. It bothered me personally . . . when it was on the steering column, I mean. Now it's on the dash . . .

To me, the beds in Nash cars are one of their most attractive features. This is how they are made up. They are standard equipment in all 2-door sedans, club coupes, and custom models, optional in some other models. Back of front seat is adjustable to five positions.

Here's one of the important things Nash has done in the new cars—you don't need to unload the luggage compartment to make up the beds. Even if you are long-legged, your feet won't stick back into it. The picture below also shows the new rear fender line.



Instrument panel of the 1951 Nash, with the Uniscope removed from steering column to dash. Fresh air passes through a dust filter before being heated or entering the car unheated for draftless ventilation. Three blowers are used for defrosting and air circulation.

The ride is feather-beddy. I don't like it that soft, myself. I want to feel more of the road. But for anyone who wants a soft ride, this is it.

I haven't opened up, but we're rolling right along. Out of the turn. Grandstands. That stretch of bricks in front has been there since the track was built.

I ought to explain about those bricks. The rest of the pavement on the Speedway is pretty smooth. That includes the four turns. They're washboardy from the incessant pounding of racing wheels, but they're asphalt. That stretch of bricks is the only brick on the track. There's a reason for that. You won't find a more sentimental bunch of men in the country than you'll find in the racing business. So that rough stretch of brick is kept for old times' sake . . .

More accelerator pressure now. The springs and shocks level out the bricks. This car isn't fast, as cars go. Nash doesn't build for high speed. That's not their long suit.

I could do with more back view . . . more of the road. A driver should be able to see more of the road in his rear-vision mirror, it seems to me. That's a fault of most of these cars with so-called "fast backs" or teardrop tails.

So far, I had found nothing radically wrong with the '51 Statesman. I liked it. It accelerated well. It had a heavy-car feel, yet actually it is in the light-car class. It is remarkably quiet. That was due partly to the fact that clearances of the rocker arms on their shafts had been decreased, reducing valve noise.

We leave the track and try the infield. The car does a good job on the potholes. Nobody could find fault with it in this department. I like the Statesman better than I do the Ambassador. It's lighter on its feet . . . even with a lower compression ratio . . .

Whew! Bump! The shock recovery is remarkable . . . due to the type of valving in the shocks, no doubt. That's new.

I took the Statesman back to the pits and climbed into the Ambassador. It had a Hydra-Matic transmission. I cast an eye over its lines before starting out.

Changes for 1951 are limited to refinements both as to styling and mechanics. The configuration generally is the same as for 1950, on both cars. Some people don't like

When the driving was over, I dropped by the Speedway garage area to say hello to Pete Clark, mechanic on the Bowes Seal Fast Special. This car, the fastest job on the Speedway in 1948, was driven by the late Rex Mays.

the styling with the enclosed front wheels. It's on the bulbous side. But choosing a car is like putting a couple of bucks on a nag at Hialeah. You do it because you like its looks or past performance, or both.

I'd like to point out one thing that maybe isn't generally known. Like them or not, the Nash lines, aerodynamically, are among the best in the business. Wind-tunnel tests show that this body has less wind resistance than many others. That's money in the pocket at the gas pump.

I started rolling the Ambassador on the track:

I'll have to revise what I said about the Statesman. I'm not so sure I like it better. She's stable . . . the Ambassador is stable . . . feels more solid. Getaway isn't as fast. But she takes care of herself at high speed. She's absolutely effortless to control.

Here the Statesman, its Speedway preview trial over, is backed up the ramp to the trailer that brought the two '51 Nashes from Kenosha.

The seating bothers me. Maybe a big man needs all this room directly behind the steering wheel and the left door. But for me . . . sitting upright and using the arm rest . . . I'm sitting crosswise to reach the accelerator. If you want room, you've got it, that's for sure. It seems to me that the brake pedal almost overlaps the accelerator. More room . . . a little more room between the two would help.

After I stopped I examined the arrangement of brake pedal and accelerator more closely. It was better than it had seemed while I was driving, but I still think more room there is indicated.

This steering is tops. Now here's something in steering. Look at this baby change course at high speed! Now for a tight-circle turn, throttled back. I don't think I've taken more than a turn and a quarter on the wheel. She turns tight.

Remember I remarked last month that I was going to come back to the subject of steering in future articles? Well, I'm a nut on safety. Try to avoid an obstruction on the road at high speed in some of these new cars with slow-speed steering gears, and you're in trouble. You just can't do it. It takes too many turns of the wheel.

Nash comes a lot closer to having the proper steering ratio than most of our contemporary cars. This is despite a boost in the ratio. The ratio at the start of 1950 production was 18.2-to-1. That's angular travel of the wheel compared with movement of the Pitman arm. During the year this was increased to 20-to-1. The latter ratio is retained for 1951. Yet Nash steering is fast enough to make it easy to park. And there's no wheel-fight. I took the Ambassador over the washboard bumps on the north turn at the Speedway without any effort on the wheel. Coming into the straightaway, she straightened right up when released.

One more turn around the track, full out. The Hydra-Matic transmission picks up more smoothly than the one on the Cadillac I used to own. They've improved the transmission from gear to gear. Still get that down-shift, though, decelerating. She's in the groove. No complaint on the turns. That takes balance. That takes engineering.

It's quiet . . . a quiet car. Let's see how the brakes act. Brakes on now . . . from full throttle. No jar from bricks on grandstand straightaway. This is a tough high-speed stop. No indication of fading. The brakes don't fade. I've known them to. It's embarrassing to have brakes fade toward the end of an emergency stop. I've known a great many cars to do just that, and it can get you into a lot of trouble.

I said good-by to the two men who had brought the 1951 Nashes to the Speedway as they reloaded the cars on the trailer and pulled on the tarpaulin sleeves. Bet they caught some shut-eye in those built-in twin beds on the way home! END

This Month's Shaw-ism

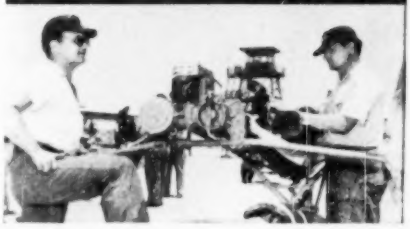
Let's don't forget that when you get into an automobile, your entire future gets in with you.

Milton Shaw

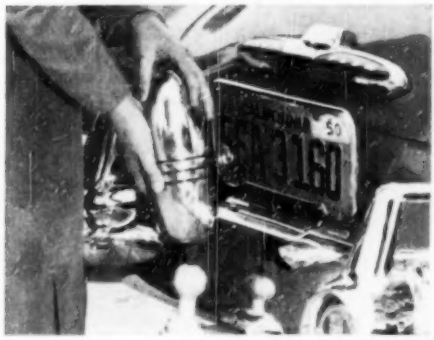
How robot plane lays wire is shown above and at right. Model hurtles from catapult at 75 miles per hour. It pulls wire that is coiled in plastic-canvas container, with a 360-degree twist in each loop so it will lie flat on the ground. Clothespin on wing tip lines up wire with drum, flies off after launching. Portable gas engine is used to start drone's motor.

Tiny Plane Lays Wire in Flight

A ROBOT plane that lays a mile of wire in 40 seconds is the Army's latest wrinkle in battlefield communications. The radio-controlled drone, originally designed for target practice, is launched from a catapult, pulling the wire out of an open-end container. At the end of the trip, the wire is dropped and the plane guided back, all by radio. With a more powerful engine in the plane, test officers think they can lay four miles of wire in two minutes. The setup is being tested by Army Field Forces, who think it would come in handy to get wire across a natural obstacle such as a river.

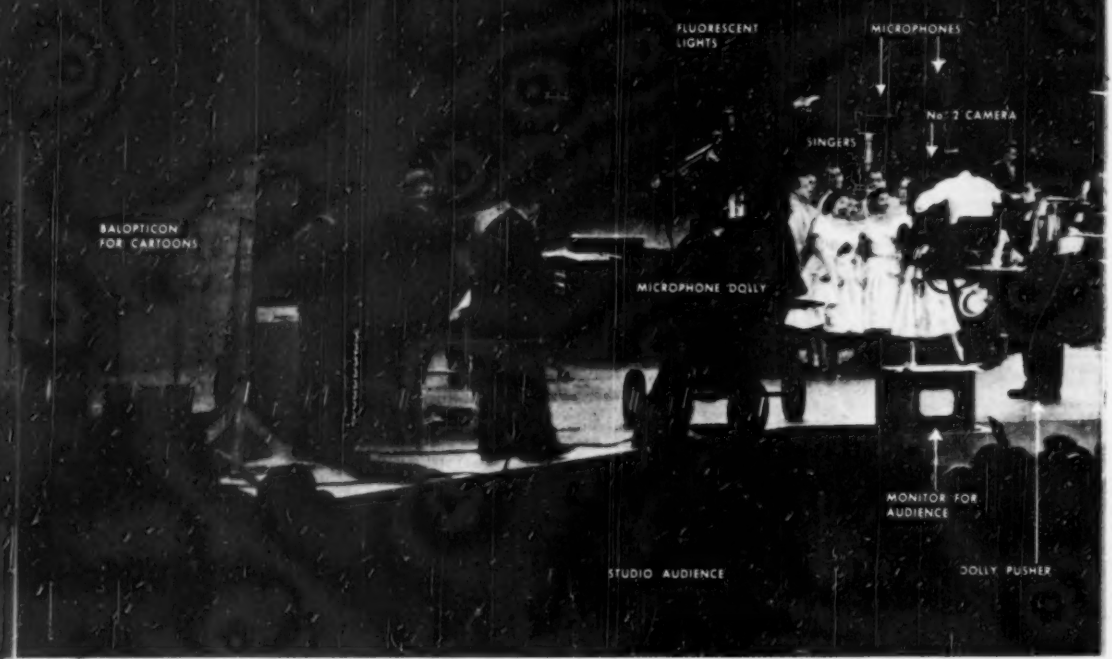


Trailer Hitch Doubles as Bumper Guard



WHEN you're not using a trailer, you needn't worry about an ugly hitch spoiling the clean bumper lines of your new car. The one at left has a chrome-plated cover that conceals the hitch ball, and serves as a bumper guard. The manufacturer says it will fit any car, and can be welded to standard three-inch hitch channel. Balls come in several sizes. An opening beneath the hitch allows use of a safety chain, and can also be used for a tow rope. The railroad-type steel base has a protective skid to prevent snagging on obstacles. It's made by Husky Hitch Co., Monrovia, Calif.

Television's Five-Ring



Here's how hectic behind-the-scenes confusion becomes the entertaining TV show you see at home.

By Martin Mann
PS staff photos

YOU'RE relaxing in front of your television set, enjoying a musical show. You see pictures that match the mood of the music—sometimes singers, orchestra, or maybe rain, clouds, a star-filled sky, often combinations of several of these.

That's the way it looks at home. Pleasant images presented smoothly, effortlessly. Easy, you think.

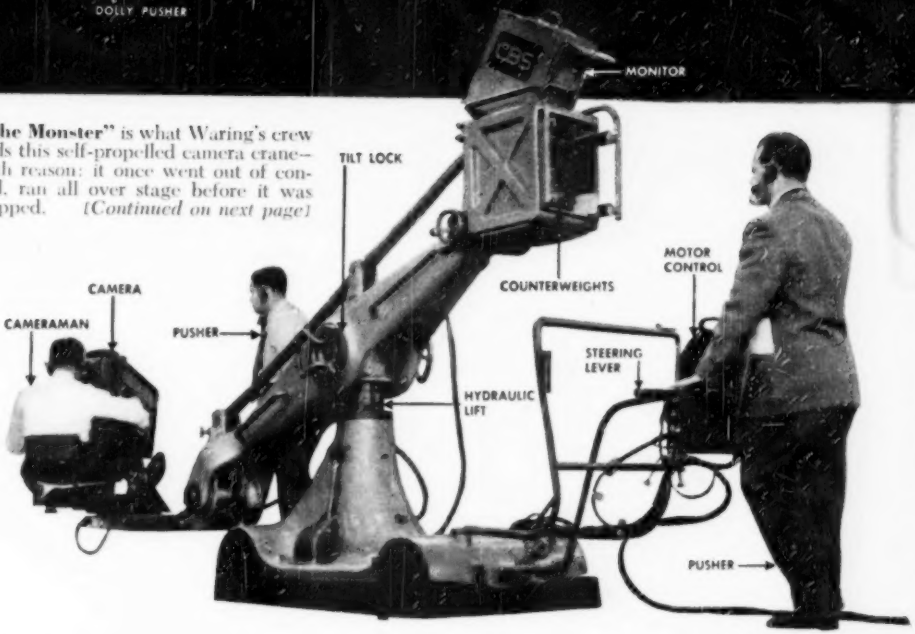
But that's not the way it looks in the television studio. There it's a frantic hour, jam-packed with excitement.

There's a tiny stage. It is overflowing with people and equipment. Everybody seems to be getting in everybody else's way, scurrying around to do apparently senseless things. As one director remarked, the only people standing still are those actually being televised.

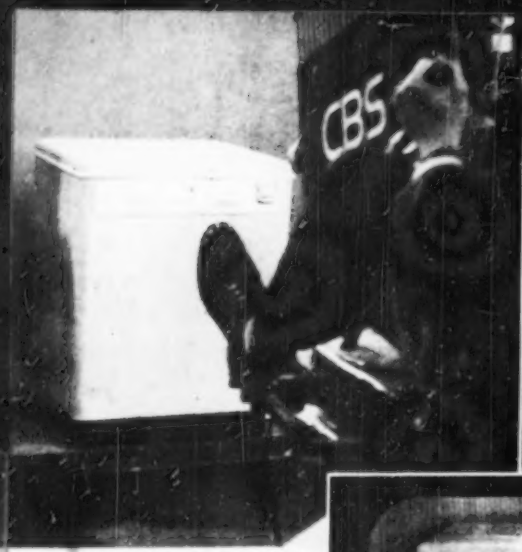
One man carefully spills water from a sprinkling can into a washtub—that's rain. Later he wiggles two pieces of black cardboard in front of a light—that's the star-filled sky.

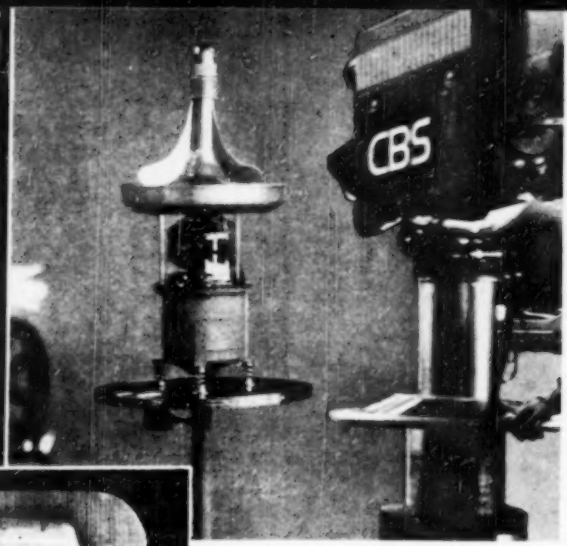
Yet all this bewildering tumult—a five-ring circus seemingly staged in a back bedroom—comes out the other end as smooth, perfectly ordered entertainment. How do they do it?

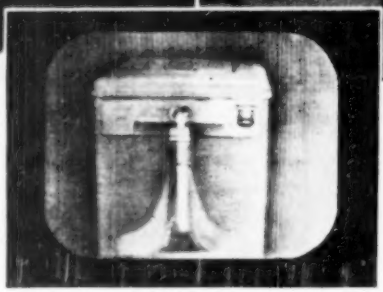
Circus



"The Monster" is what Waring's crew calls this self-propelled camera crane—with reason: it once went out of control, ran all over stage before it was stopped. *[Continued on next page]*







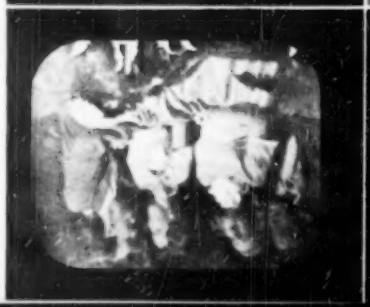
An "X-ray" view of the sponsor's washing machine was the order from the advertising agency. This one was easy for the video crew. Camera No. 2 moved up to shoot a complete washer (above, left), while camera No. 3 focused on a separate agitator unit on another part of the stage (above, right). In the control room, the two images were merged. The result, as it looked to the TV audience at home, is shown in the small picture in the center—the moving agitator seen through the washer.

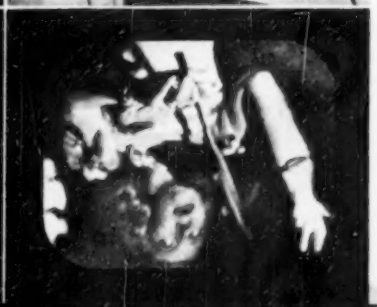
How TV Tricks Fool You So You Like It

What you see in a television studio doesn't look much like what you see on a television receiver at home. Crude wooden troughs—and even plain washtubs—become spacious reflecting pools; a couple of pieces of black cardboard with light behind them make twinkling stars; a few branches of artificial leaves create the impression of a whole garden. In the photos at right you can see typical video staging tricks. The top pictures were made in the studio from behind the TV camera or cameras in use, while the bottom ones show what the television audience saw—they are actual photographs of the screen in the receiver at Chief Photographer Bill Morris's home.

Wooden trough with few inches of water made garden pool for "springtime" shot of singers (bottom). Technicians wiggled fingers in water to create ripples.

Reflected view of violinist—she was at other end of stage—was made with just a washtub.





It requires a combination of magic, ingenuity, and plain hard work. By comparison, making movies is easy.

Take the Sunday-night Fred Waring Show, one of the best and most complicated productions on the air. Come backstage with POPULAR SCIENCE and you can see video legerdemain at work. Regular spectators—they pack the Columbia Broadcasting System theater from which the show originates—hear little and see less, for the performers are hidden by scenery, equipment, and a stage-wide wall of fluorescent lights. But you can follow the PS cameras and reporters behind the scenes, on the stage itself, and even into the tightly guarded video control room.

The first thing you notice is the stage. It looked spacious on your screen at home, but actually it is only 50 by 70 feet.

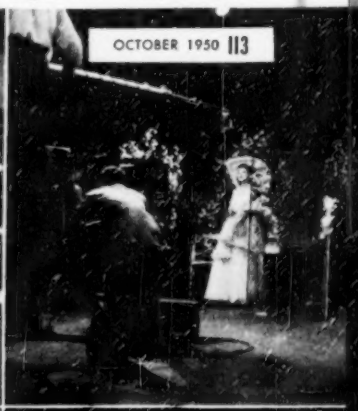
And what they've crammed into that space! There are 69 of Fred Waring's Pennsylvanians and all their instruments—including a pair of grand pianos, two harps, and a celesta. There are more than 40 technicians behind the cameras. There are three big TV cameras, one mounted on a crane the size

A washtub and garden sprinkling cans are essential equipment in a TV studio—they make "rain." Image picked up by this camera is superimposed over the picture of the actors.

Standard Balopticon projector put "jalopy" cartoon on movie screen so TV camera could pick it up.

"Stardust" is played by Morley and Gearhart as stars twinkle appropriately. Stars were holes in cardboard, lighted from behind.

At home it seems Joan Wheatley is singing in a garden. Actually, there are only the gate and a few branches.



of an automobile. There are two microphones on dolly-mounted booms. And there are all kinds of miscellaneous paraphernalia ranging from three of the sponsor's washing machines to a galvanized washtub used in a trick-effect scene.

Yet imaginative tricks make the show look as if it were put on in a giant Hollywood sound stage. In one corner of the stage is a sloping wooden ramp. When the glee club stands on the ramp, and the camera focuses on a singer standing in front of it, the effect is of a chorus stretching far into the distance behind the soloist. Actually all are very close together.

Platform Stretches Space

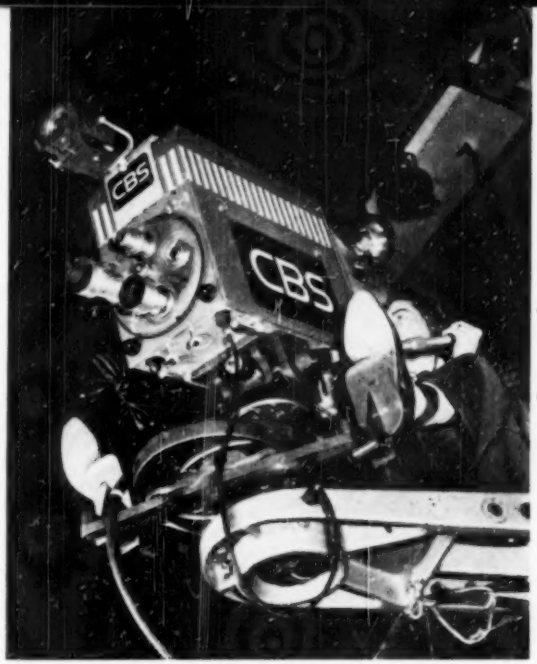
Another space stretcher is the platform extending back from the stage out over room stolen from the audience. It looks like the runway in a burlesque theater, but no chorus cuties parade down this ramp. The big camera crane rolls back on it for long shots that include almost the whole stage.

That camera crane itself—a $7,000 electrical, hydraulic, and mechanical marvel—plays a major role in creating the illusion of space. It can shoot the camera up 14 feet high, drop it to floor level, swoop it around in graceful, tilting circles, glide it in and out. Its versatility gives the pictures you see at home that all-the-room-in-the-world-to-move-around-in feeling. Yet in making those pictures, it continually shaves close to performers and equipment.

Four Ways to Turn

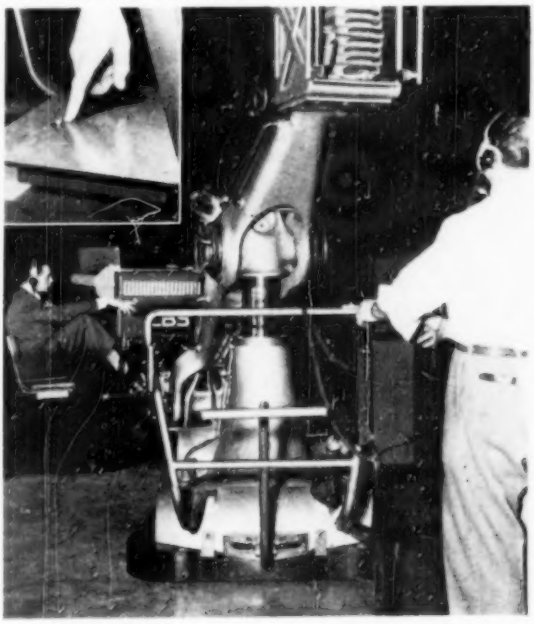
It is an intricate, cast-metal seesaw—camera and cameraman on one end, counterbalancing weights on the other—that tilts and swings on a barber-chair hydraulic lift that rides on an electrically driven cart. All sorts of combination movements are possible. The seesaw not only tilts through most of 90° but also rotates horizontally through nearly 360°. The camera platform has a foot-operated semicircular gear that swings it through 180°. The camera itself can also spin on its "pan head." And the cart turns like a coaster wagon. This means there are four separate ways to swing the camera. Without co-ordination among the cameraman and the two dolly "pushers," all four motions can work against each other—with everything moving but the camera itself!

Waring's crew calls the crane "The Monster." It is one. It's by far the biggest machine on the stage. And it looks alive. It



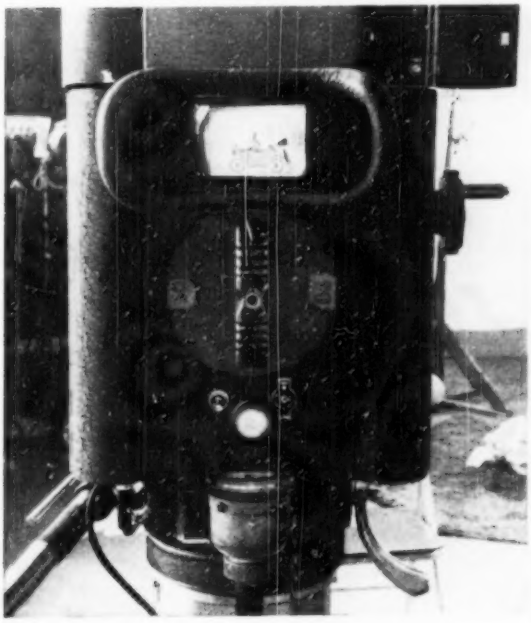
Versatile crane provides several independent ways to swing camera. By pressing on footrest (above), for example, cameraman moves semicircular gear that turns camera and himself.

Counterweights that lighten job of tilting crane can also be a hazard—if cameraman jumps off seat, arm shoots up. To prevent this, automatic switch on seat (inset) locks tilt mechanism.



Cameras Nos. 1 and 3 are mounted on heavy "pedestals," which must be handled entirely by cameraman. Pat McBride (above) shows how he raises camera with foot while hands are busy.

This is what you see through a TV camera's viewfinder (below). Viewfinder is electronic, not optical, using small cathode-ray tube. Knob at right focuses, big handle changes lenses.



can be positively frightening to spectators in the front seats when its camera-bearing arm swoops by inches overhead. A new model now on order will look even more weird—both its arms will telescope in and out, besides doing all the things the present Monster does.

Control Room Has Best View

The best place to catch the tense spectacle of a show being televised is from the video control room. You can see everything each camera sees on the monitor screens that crowd the small room. You can watch the behind-camera action through the big windows. You can hear the performers. And you also hear at least half the directions and warnings that stream between the technicians in the control room and those on the stage—all are hooked into a party-line intercom system.

The control room itself is an exciting place during the show. In the front row sit two "shaders," technicians who adjust the quality of the picture from monitors connected to the individual cameras. Behind them are the three men who control what the audience sees. They watch the stage, the individual camera monitors, a fourth monitor that shows the picture selected for actual telecasting, and a fifth one that shows the picture leaving CBS Master Control.

The associate director, Bob Simpson, follows the script and warns the cameramen where to move for their next shots. Alongside him is Bob Banner, the 28-year-old director-producer responsible for the show. He voices the actual commands. With just a hint of the Texan's slowness in his voice, he will tell Al De Caprio, who operates the Monster-mounted No. 2 camera, "Move in closer, two. Tha-a-at's it. Okay! Take Two."

The "Switcher" Does It

This last order puts Camera Two on the air. For then Frank Protzman, the technical director, or "switcher" (he sits next to Banner), punches a button on his little control panel—and everybody at home sees what Camera Two sees.

It's not always this easy. Sometimes a camera will run afoul of wires at a crucial moment. Then the atmosphere inside the control room sparks with barked commands —"Get in position! Get in *position!*"

More often it's just the complication of arranging a big cast and crew for tricky

Hour's closing words are spoken by Fred Waring from his podium, which has built-in TV monitor so he can watch show while taking part. Card held by assistant has Waring's notes.

shots while the show is on. Like the "Stormy Weather" scene, which called for the two pianos to be shown through driving rain.

Associate Director Simpson "readied" Camera Three, saying, "Three, move over for the rain." Camera Three was then turned around and focused on the water spilling from a sprinkling can into a tub.

Director Banner watched the "rain" on Three's monitor and also the picture of the pianos already being telecast from Camera Two. At the right moment, he made a graceful, twisting motion with his hand and said, "Super Three."

Switcher Protzman then worked two small levers on his control board, superimposing the rain picture from Camera Three *over* the piano picture from Camera Two. Televiewers at home saw the pianos through a sheet of rain.

Other tricks—a background of stars for the "Stardust" number, an inset of a soloist's head over a shot of the glee club, a china cat sitting on the piano keyboard for "Kitten on the Keys"—are done much the same way.

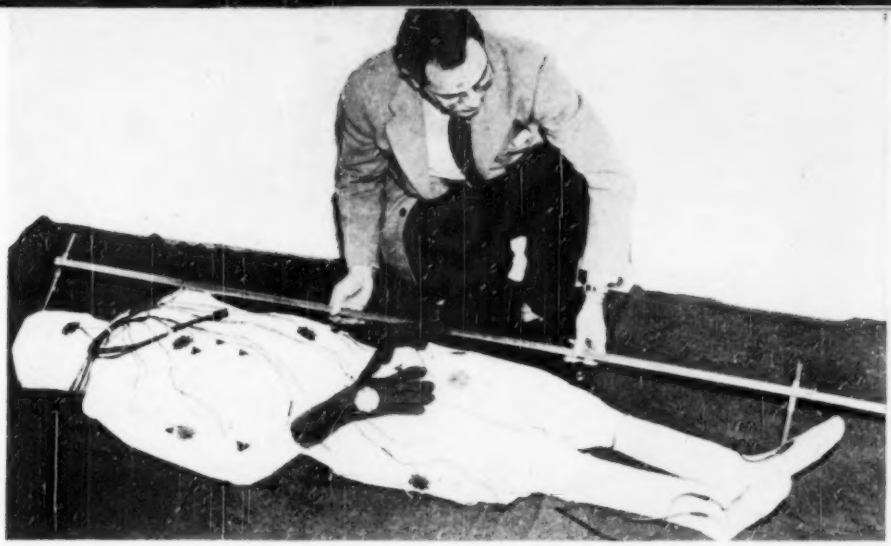
The tense pace continues in the control room until Fred Waring says, ". . . Thank you once more for inviting us into your home. We hope to be with you again next week. Good night."

Camera Two dollies back for one of those long, long shots, while Camera Three dollies in for a close up of the General Electric emblem. This is the last super. It's over.

But even then Banner and his crew don't relax. They're already thinking up new tricks and sequences for next week. END

400 Pictures for One Story

Covering the Waring show was one of the biggest photographic assignments tackled by POPULAR SCIENCE in recent years. Chief Photographer Bill Morris directed a crew of seven, who shot more than 400 pictures with a dozen cameras ranging from studio view jobs to 35-mm. miniatures. And that doesn't include the photographic "notes" made on the scene by cover artist Denver Gillen with his camera. The whole thing was done in one week end, during the rehearsals and actual performance of a single show.

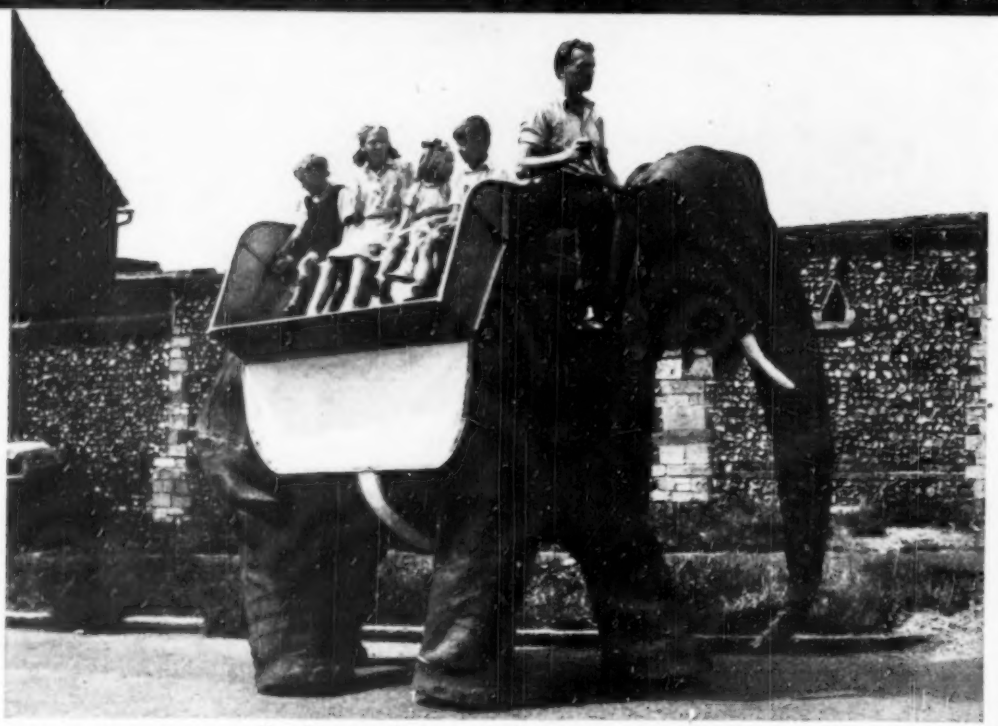


Dummy Tests Sleeping Bags

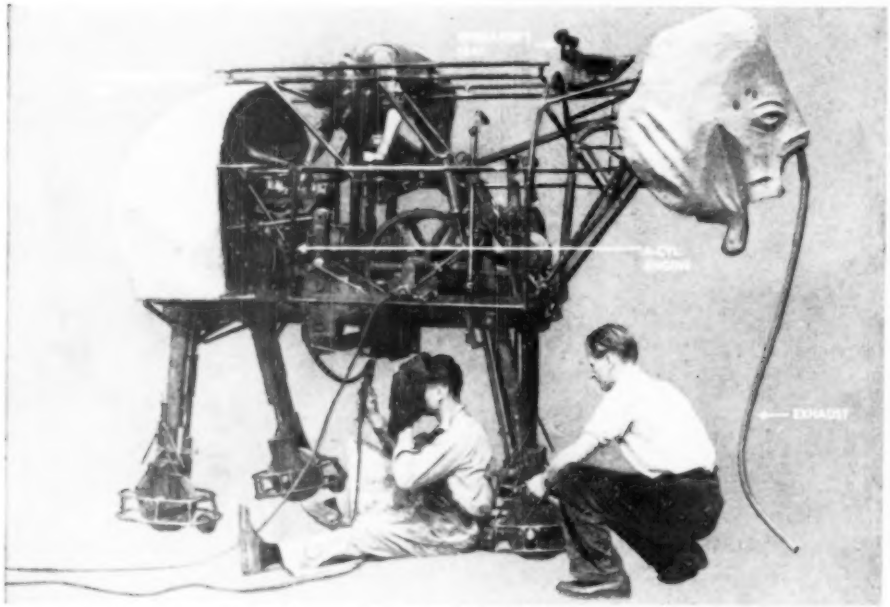
NICKNAMED "Lumpy," because of the tendency of his stuffing to bulge, the life-size dummy above helps the Army try out sleeping bags. He wears long underwear and a number of electrical heating elements. Observers tuck him into a sleeping bag and turn on the current. How rapidly the elements warm up shows how much heat is retained by the bag and, hence, how well it will protect a user from cold. Currently, 24 bags of different sizes are under test at a Quartermaster laboratory in Lawrence, Mass.

Garage Door Is Lightweight

LIGHTWEIGHT garage doors of aluminum now are built like airplane wings by the Tubular Aircraft Products Corp., Los Angeles. Corrugated for strength, the skin is flush-riveted to channel and X frames. Easily lifted (left, above), a finished door weighs only 42 pounds. It may be left in its gleaming natural state or painted, and raised by an electric motor or a spring-balanced fingertip control. Two single doors, joined together, form the double doors of the garage pictured at right above.



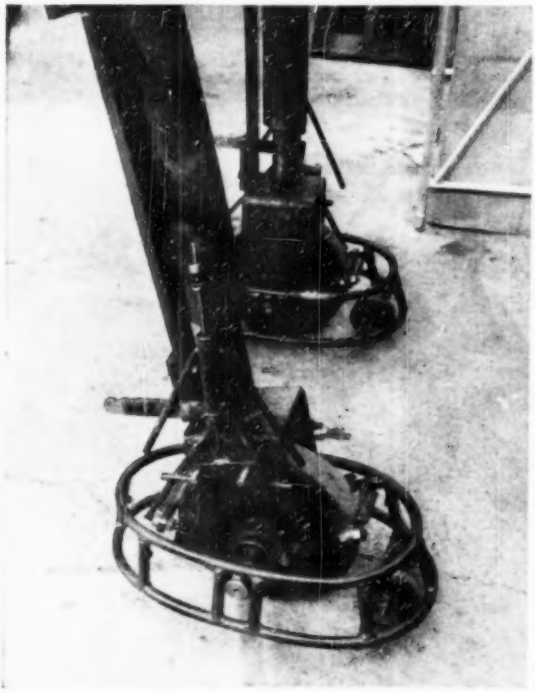
A ride on this elephant, actually a life-size robot, gives children all the thrills of a ride on a real pachyderm. He can toss his trunk, flap his ears, and is said to march at speeds up to 28 m.p.h.



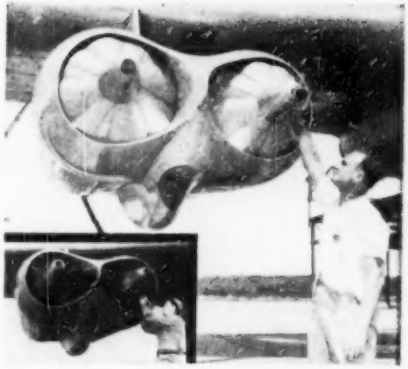
Jumbo's insides consist of 9,000 parts housed in a big frame of welded steel tubing. A four-cylinder engine from a British Ford, located at the back of the elephant, activates a system of links that transmit power to leg rods to make it walk. The trunk is actually the engine exhaust. The mechanics in the photo above are putting the finishing touches on the animal.

Elephant Driven by Engine

ABOUT the only thing that this mechanical elephant can't do is mooch peanuts from small-fry visitors. Built in England by Frank Stuart, Jumbo gives rides to children in amusement parks. What's more he can flap his ears and wave his trunk. Measuring 12 feet long and eight feet high, the robot has 9,000 parts housed in a steel frame. His "hide" is toughened paper. A four-cylinder gasoline engine, at the back of the animal, powers the movable parts of the body through a system of cranks, cams, and connecting rods. The pseudo-pachyderm costs about $3,000.

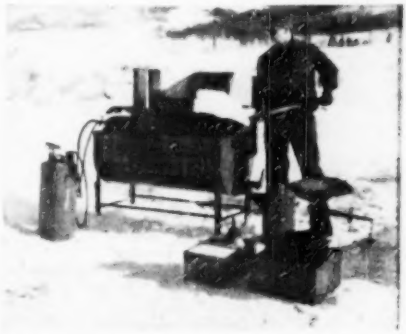


Big wheel in each foot carries load; smaller wheel in front just guides enclosing frame. Each main wheel must be locked at right time as elephant walks to prevent leg from rolling back.



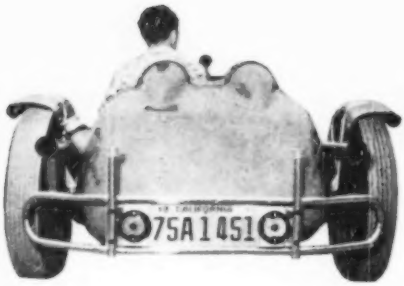
Jet Intakes Get Doors

DOORS are now installed on the intake end of some Air Force jet engines to keep out foreign objects when a plane is on the ground, and to reduce wind drag during flight when the engine is not in use. The photo above shows the covered intake of a Convair B-36; both bombers and reconnaissance planes of this type are equipped with four jet engines and six pusher-type piston engines. The inset shows how the intake looks when it is uncovered. The doors are switch-operated from the pilot's compartment.



Snow Becomes Drinkable

IN ARCTIC regions Navy personnel get drinking water from this snow melter. When snow is shoveled into the hopper, as above, it is liquefied by heat roaring through a pipe inside the melter. Using gasoline or Diesel fuel, the kettle produces about 50 gallons of drinkable water per hour. Water is drawn from a faucet at the bottom of the melter. Scales on the ground are for weighing water.



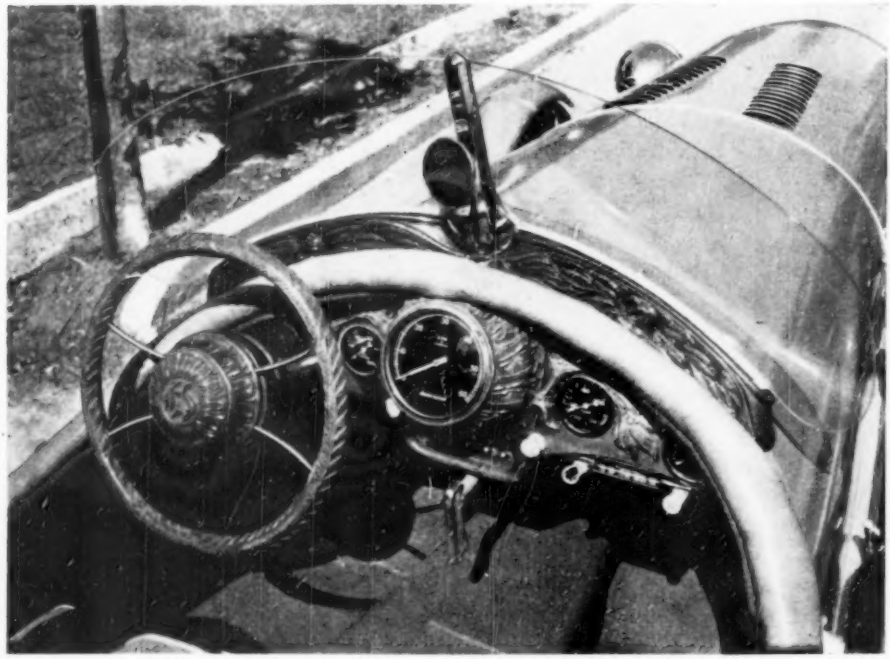
Ford + Willys = Sports Special

AMONG the beauties of Southern California are sleek speedsters like the M.G. Midgets envied by Fred Stammer, of Burbank. He couldn't afford one, but he wanted one. So, by wedding a junked 1936 European-style Willys "77" chassis to a Ford V-8 "60" engine, he got one.

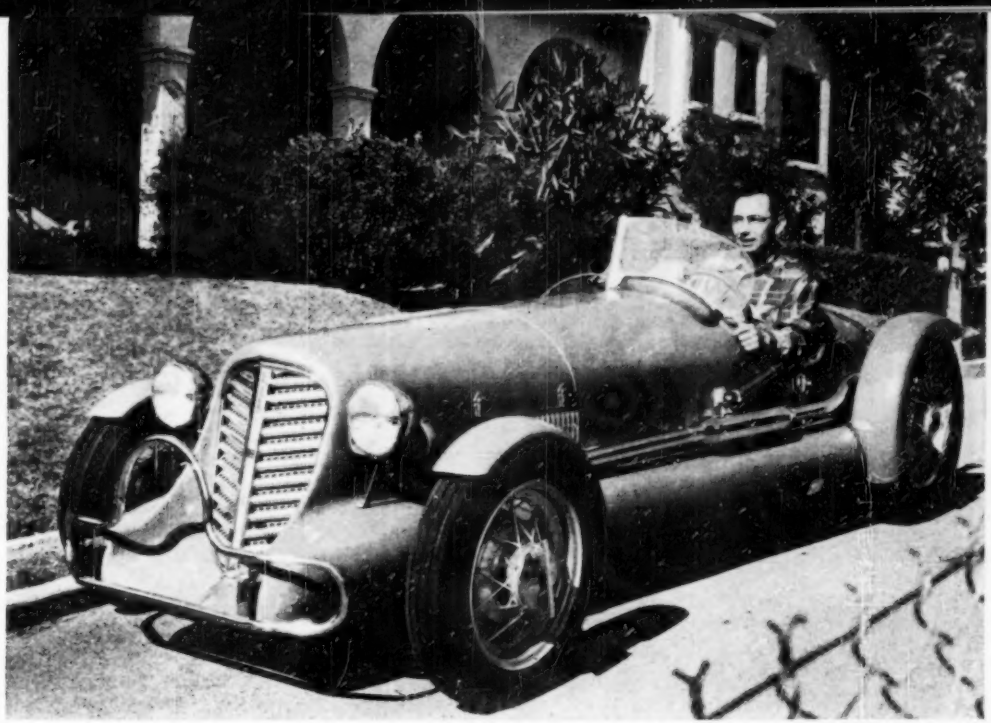
The marriage ceremony was hard work and a lot of ingenuity.

A slick, robin's-egg-blue paint job hides the more than 1,000 aircraft-type flush rivets that hold the body of Stammer's de luxe jalopy together. Being a sheet-metal worker at the Lockheed aircraft plant helped him to do a good job on it. The Willys chassis was stripped down to frame rails, axles, and steering gear. Shortened and narrowed, the frame is powered by a stock Ford engine, reworked to purr at better than 5,000 r.p.m., and has a homemade water-injection system, via the air cleaners, to coax more speed.

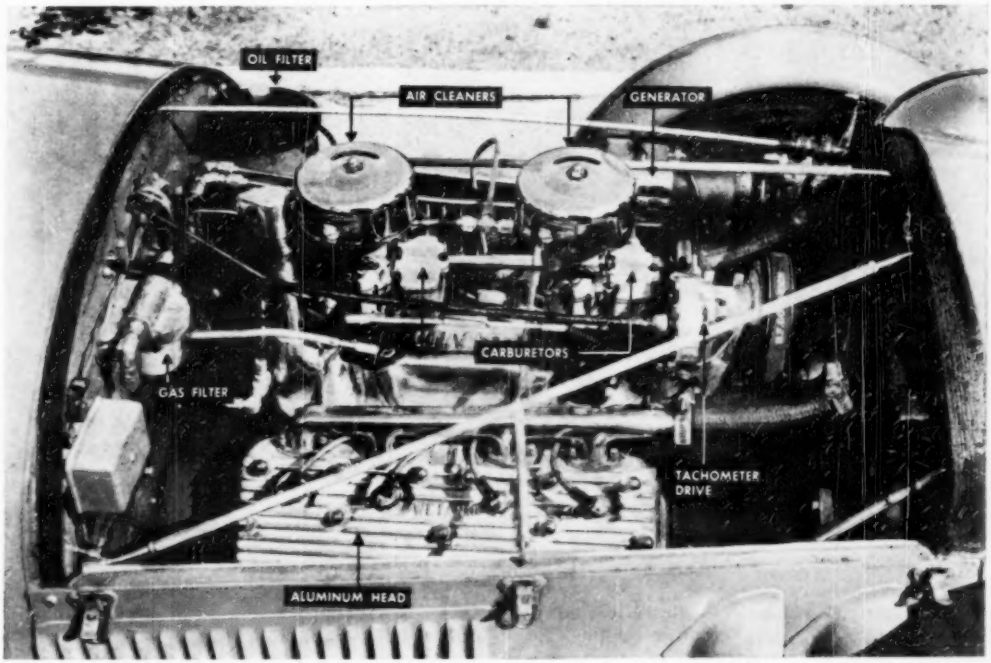
A 1,600-pound lightweight, the car just edges over 34 inches at its tallest. Wheel base is 98 inches, and axle ratio 4.17 to 1. A remote-control handle of aluminum does the gear shifting, and the Willys cable-operated brakes are intact. Instruments include tachometer, ammeter, oil-pressure, temperature, and vacuum gauges. Stammer built the tachometer drive himself.



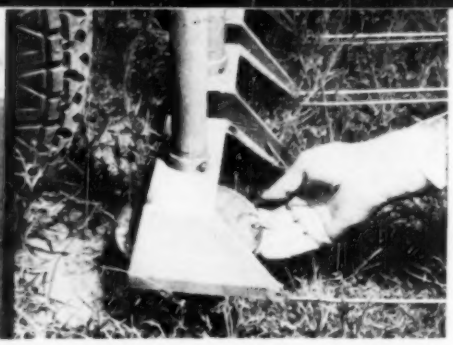
Luxury touch is hand-carved Mexican mahogany steering wheel—with steel core—and dash. Cockpit is lined with fine, pleated leather. Panel has tachometer, but no speedometer.



Builder is snug fit. Rear mudguards, side mufflers are motorcycle parts; windshield, Lucite.

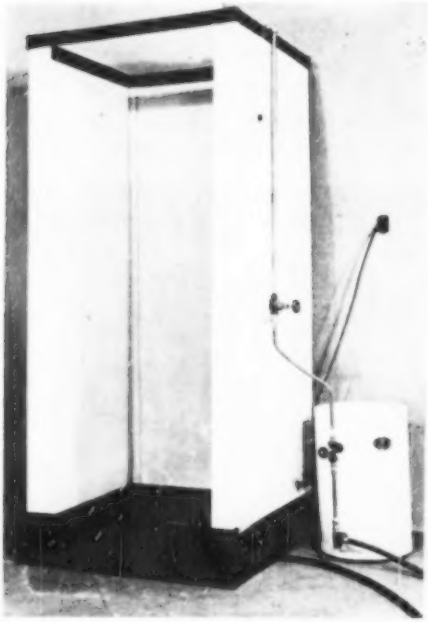


Stock Ford V-8 "60" engine was fitted with twin carburetors and a pressure tank to supply water injection through air cleaners. Heavy-duty, truck-type oil filter is used.



Machine with Whirling Razor Blades Kills Weeds

AMERICAN growers of flax straw—used to produce linen—may be in a better position to compete with European producers as a result of this weed eliminator. Designed by Floyd Grapp, of the University of Minnesota, the machine straddles rows of the closely planted crop. Between each pair of rows a shaft descends to a rapidly whirling disk holding four razor blades. The disks, operated close to ground level, cut down the weeds while leaving the flax undisturbed. This enables the flax to be harvested without an accompanying crop of weeds, which would lower its quality.



Shower Connects Up Easily

NEITHER a plumber nor an electrician is needed to install this combined shower and electric water heater, produced by Barton Products, Inc., Defiance, Ohio. Water is supplied and drained away by hose. The heater, controlled by a heavy-duty thermostat, can be plugged into any outlet. A mixing valve adjusts the proportion of hot and cold water supplied to a special, aerator-type shower head.

Multi-Metal Turbine Alloy

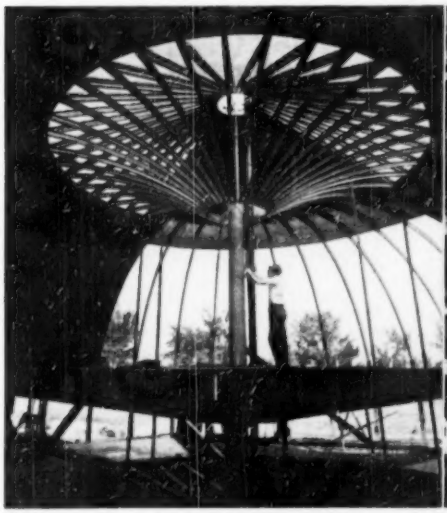
SEVEN metals are combined in a modern gas-turbine alloy, called Inconel X, which withstands temperatures up to at least 1,500° F. In decreasing order of percentage, ingredients include nickel, chromium, iron, titanium, niobium (which up until recently was called columbium), aluminum, and manganese.

Steel-Wool Muffler for Planes

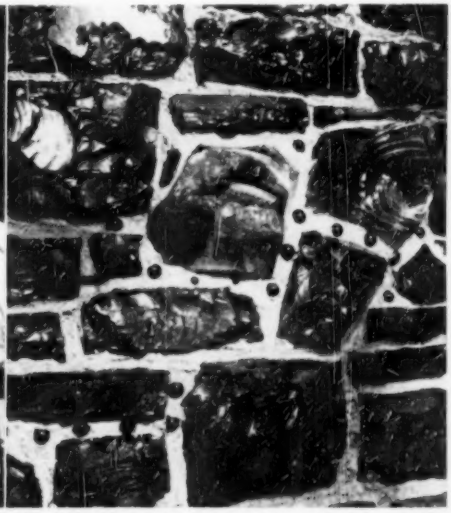
ENGINE noise is reduced as much as 60 percent without loss of power by a lightweight aircraft muffler developed by Aero Sonic Corp., New York City, and installed on plane above. Sound is absorbed by stainless-steel wool blanketing, rather than baffles. Venturi curves on the tailpipe help scavenge exhaust gases, and an air scoop in front helps prevent backfires. It is CAA-approved for 450-hp. engines.

House Built In-the-Round

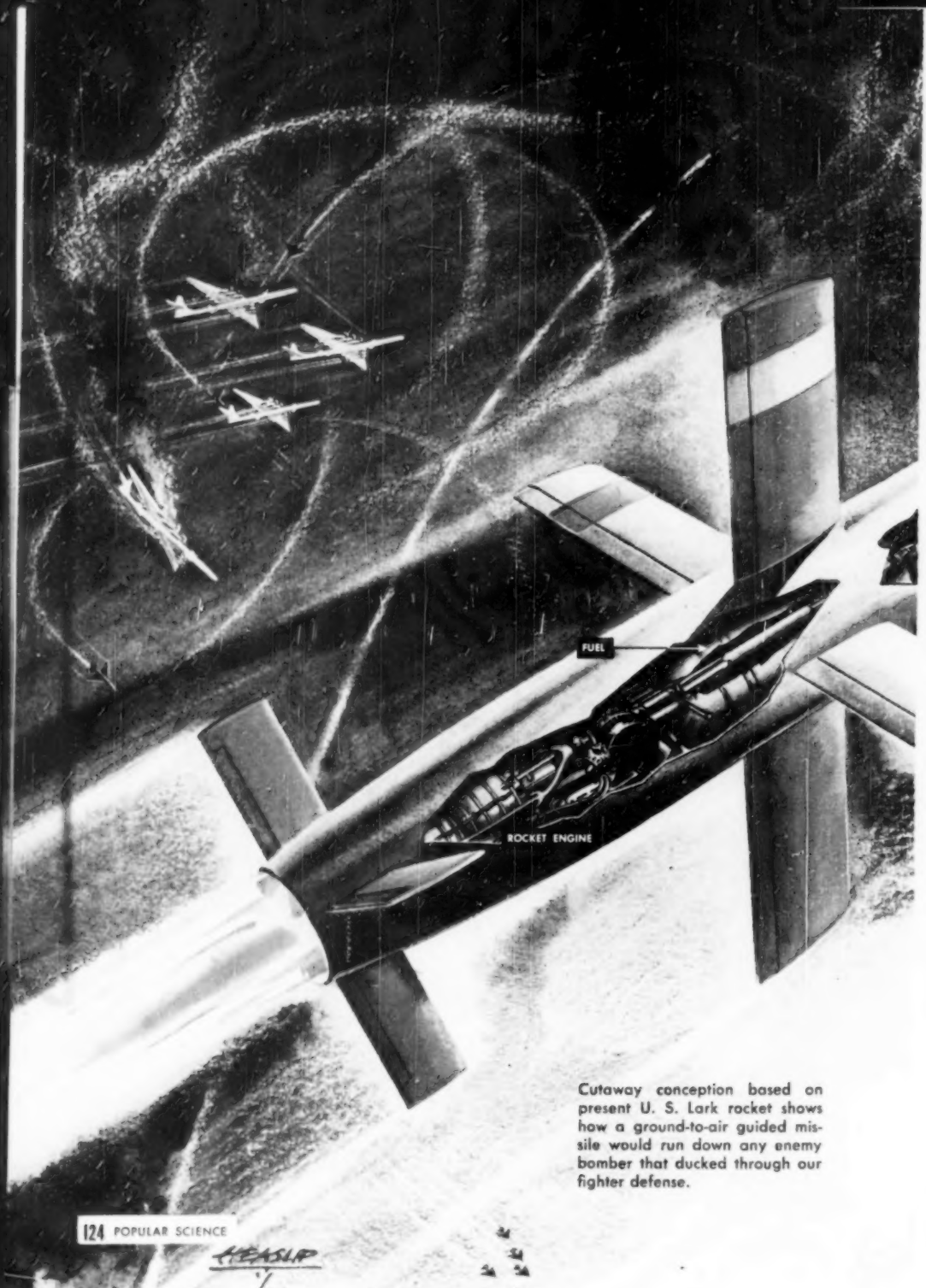
THE odd-looking structure above isn't a native African chief's hut. It's an ultra-modern house designed for A. G. Ford, of Aurora, Ill. Built on a framework that resembles an open umbrella, it has no conventional doors, walls, ceilings, or windows. A cedar-shingle roof, resting on steel ribs, covers most of the house. On top is a glass dome. An open section, seen in the photo at left below, will be screened. A grassed terrace will extend into the living quarters, with plate-glass walls protecting the rest of the interior from the elements. At each end of the house is a smaller half sphere, containing bath and bedroom. A carport completes the unusual architectural treatment.



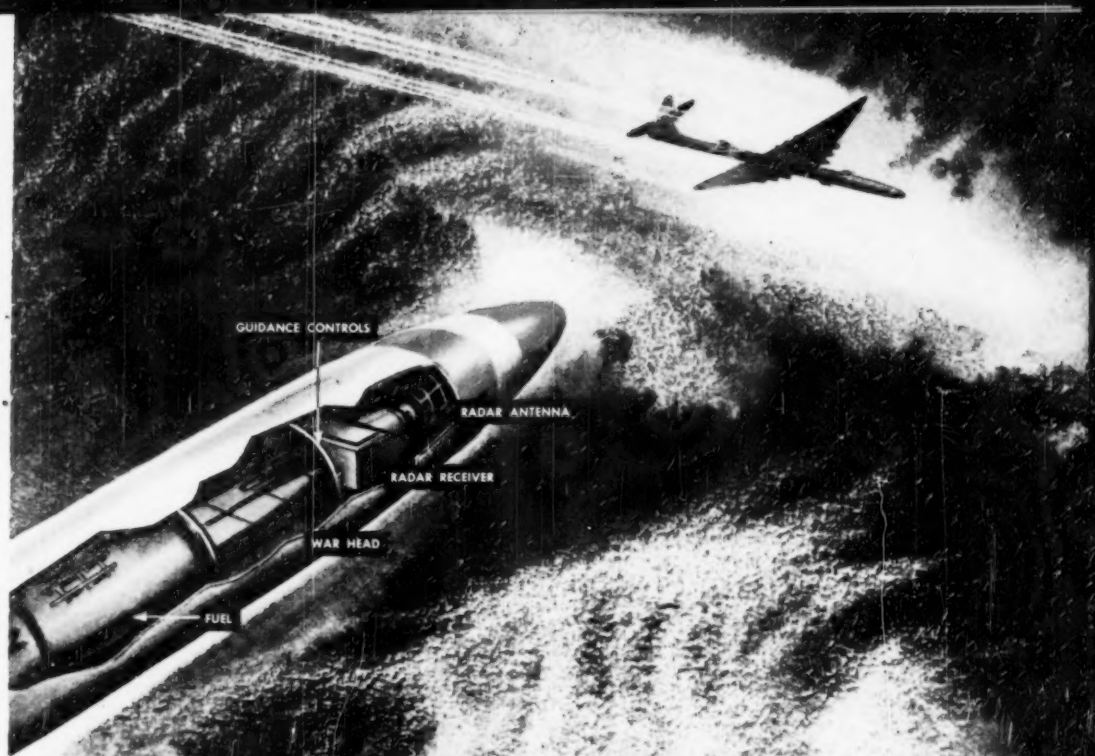
Only interior structural support is a central steel beam from which ribs extend outward like an umbrella. Raised platform will serve as a studio for Mrs. Ford, an artist.



Highly-polished chunks of cannel coal and thick blocks of blue-green glass are combined to form a striking, massive wall. Brightly colored glass marbles are embedded in the mortar.



Cutaway conception based on present U. S. Lark rocket shows how a ground-to-air guided missile would run down any enemy bomber that ducked through our fighter defense.



Missile's Mission: Picking Off the Strays

Knocking down tomorrow's sneak A-bomber is a job for a flying torpedo with built-in radar eyes and its own vacuum-tube brain.

By William S. Friedman

DRAWINGS BY WILLIAM HEASLIP

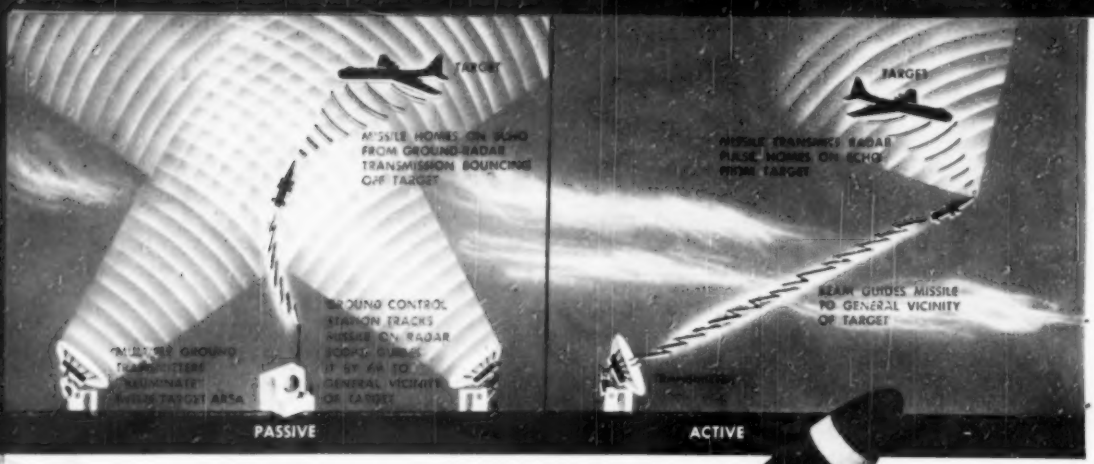
BEFORE Hiroshima, a lone enemy plane was hardly worth an air-raid alarm. Tomorrow, that single plane—a stray or a lone wolf depending on surprise—could be the one with the A-bomb. The vital need to pick him off short of his target is one of the reasons our defense planners are grooming a growing stable of guided rocket missiles.

Their big difference from the conventional rockets and antiaircraft projectiles used in Korea is that these birds with vacuum-tube brains can *change course* after take-off. Can follow a speeding target and blow it out of the sky, no matter how it tries to turn away.

For an idea of what it takes to do that at bullet speed, take a look inside the Lark—as sketched at left.

This ground-to-air torpedo is not the newest of our guided missiles: others, still under wraps, include slim supersonic killers for launching from planes. But the Lark is the one we can talk about now, and it's probably the one with the longest history of flight-tested modifications. Fairchild Engine and Airplane Corp.'s Guided Missiles Division, Farmingdale, N.Y., recently received orders to turn out the latest version for all three services—Army, Navy, and Air Force.

Today's Lark is a lineal descendant of the XSAM-N-2a, an antiaircraft missile developed late in World War II to knock down



Two ways to guide a missile: In Passive System (left), missile, carrying only radar receiver, aims at echo of signal broadcast from ground. In Active System (right), missile carries transmitter too, is strictly on its own during final run at target.

Lark launcher is ramp that can be raised or lowered. Hitched to missile's tail is take-off booster—a square frame fitted with two solid-fuel rockets. These give Lark extra initial thrust. When they burn out, frame, held only by rockets' push, falls off, and missile keeps on.

Kamikaze attacks on our Pacific Fleet. Its new designation, CTV-N-9, means that the present model is a "Component Test Vehicle"—a means of testing the accuracy and military usefulness of some part of the missile, probably its guidance system. The N is the designation of Fairchild products, and the 9 indicates the number of modifications so far—evidence that the Lark is close to combat use.

To look at, the Lark is a streamlined fuselage, thicker than a man and about 14 feet long, with four stubby wings sticking out at right angles to each other. A similar cross-shaped tail is set at a 45-degree angle to the wings. Hinged panels on the wings control steering; those on the tail, climb and dive. Bank and roll are controlled by retractable ailerons that extend from the wings when needed.

For Combat, War Head Would Be Added

Inside, the Lark carries its electronic guidance system in the forward section. For combat, this would also contain a war head and detonating gear. The fuel system is amidships, and the engine aft.

This rocket engine, built by Reaction Motors, Inc., burns analine, a powerful coal-tar derivative, oxidized by red fuming nitric acid. Those fluids are force-fed into the combustion chamber by compressed gas. Since the two fuels burn on mixing, no ignition system is necessary. The combustion gases, jetted to the rear, give the Lark its terrific thrust.

Just how the Lark tracks and homes on its target the military isn't saying. The target-seeker system could be either of the two basic missile-guidance schemes, or some combination of them. These were explained recently by Prof. Hermann Oberth, rocket scientist who developed the V-2 for the Luftwaffe. He told how the Germans developed both systems for missiles built in 1943-'45 in hope of stopping the Allied air offensive.

In the simpler, called the Passive System, a control station on the ground tracks the fleeting missile by radar and directs it by FM radio signals to the general vicinity of the target. There the missile's own seeker mechanism takes over and homes on the echoes of ground-station radar as they bounce off the target.

In the more complicated Active System, the rocket rides to the target area on a thin ground-radar beam that tracks the target

Just after take-off. Lark trails dense white smoke from the solid-fuel booster rockets, similar to JATO bottles. A moment after this picture was taken, the booster fell clear.

like a searchlight beam. On its way, the missile, carrying its own miniature radar transmitter as well as receiver, also scans the sky. And once it sights the target, the missile cuts off from the ground-projected beam and heads after the enemy on its own.

The big advantage here is that accuracy of aim actually increases on the final target run, instead of diminishing with the distance from the ground station. One disadvantage is that the flea-powered radar transmitter you can at present pack into a missile has a narrow scanning cone. It may miss the target altogether. High-efficiency miniature electronic gear may lick that problem.

Informed speculation on the ground-to-air missile's coming role figures it to take the place of conventional antiaircraft artillery and short-range fighter planes on the inner perimeter of defense as bombers fly higher and faster. On the outer perimeter would be radar-bearing patrol aircraft. These, with early-warning surface radar on land or at sea, would vector carrier fighters or long-range interceptors to the combat area. Any enemy survivors that came closer would be in range of a second ring of fighters.

Still there's that possibility of a few planes—maybe only one—sneaking through. And you can never tell which one may have the A-bomb. Picking off those strays just short of their goal is a job for the Lark, or something like it, taking off from a ring of launching sites surrounding the defended area.

For a guided missile has more than just speed, range, and accuracy. The Lark's four-way wing arrangement—completely impractical in a man-carrying plane—gives it immense advantage in combat maneuvering: one set of wings is always in vertical bank position, required for the sharpest turns. And a missile can take acceleration that would pull a man apart. It doesn't black out in the tightest turns. It has no survival instincts to make it veer off course when the danger becomes too great. Its electronic brain has only one idea: to seek out and destroy the enemy. END

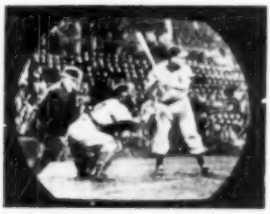
PS Readers Keen About New TV Photo Hobby

SEVERAL nights each week a mechanic in Ohio focuses a camera on his TV screen and settles down to make a few more shots for his album.

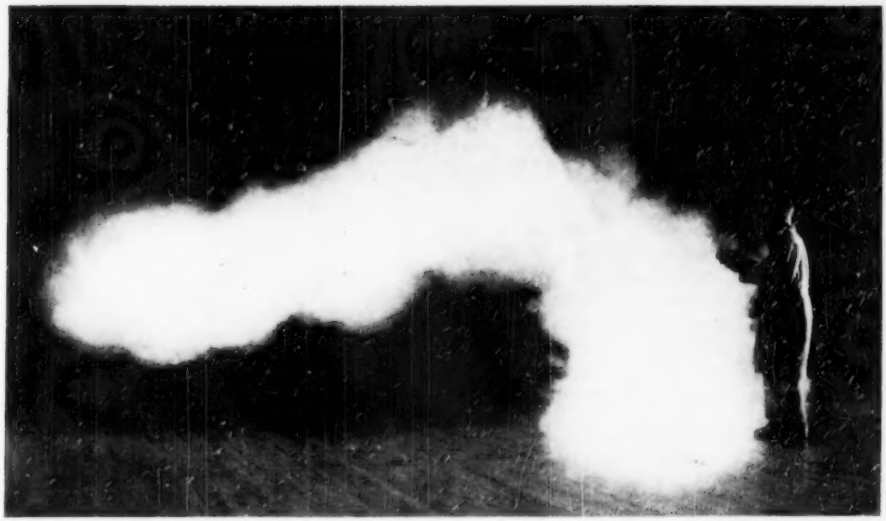
From previous failures, the mechanic now knows exactly what to do to get good shots. He sets the camera firmly on a tripod, puts on a portrait lens, and moves in close for a big image. He makes sure of his focus. He opens the diaphragm fully and sets the shutter at a slow speed—anywhere from 1/5 sec. to 1/25 sec. And then, with his finger on the cable release, he waits for the moment when his subjects are moving least.

Have you tried this fascinating new hobby? Suggested by POPULAR SCIENCE (Aug. '50, p. 184), it is enabling many amateur photographers to have as much fun at home as others have on vacation trips. Below are two examples of their work. More will appear in future issues.

Gloria Swanson, appearing as a guest star on station KING, was photographed by Charles E. Lundberg, of Seattle, Wash. He used a Rolleicord with a #1 Portra lens over its regular Triotar. Exposure was 1/10 sec. at f/3.5 on Plus X 120 film. Scene was shot from a 12½-inch screen.

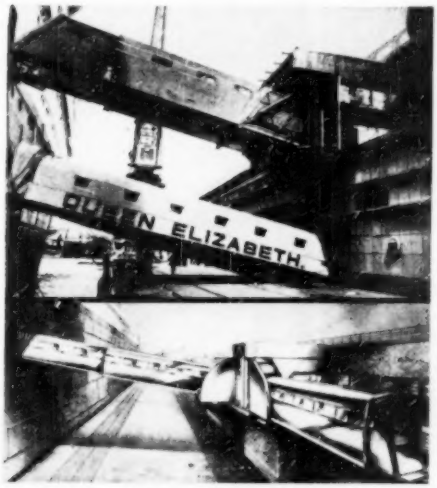


This baseball scene was shot by Jim Feron, of Kew Gardens, N. Y., when the Dodgers played the Indians on July 24. He used a 1/25-sec. exposure at f/4.5 with his Bantam camera set 2½ feet from the 10-inch screen. This gave small image. A portrait lens would have given a bigger one—and a better photo.



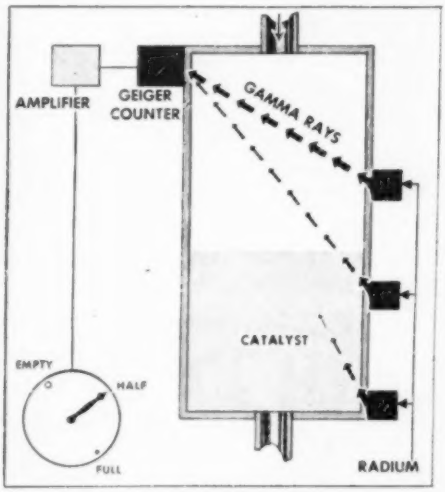
New Louvers Aim Heat Anywhere You Need It

HEAT can be aimed like spray from a hose with new air diffusers for the high-mounted "unit heaters" used in many big buildings. In the demonstration above, smoke is being sent two ways at once to show how one heater could warm both a doorway and a store counter. The diffusers are made by Trane Co., La Crosse, Wis.



New Gangplanks Telescope

TELESCOPING aluminum gangplanks have replaced the old-fashioned kind for connecting luxury liners with the $2,700,000 ocean terminal at Southampton, England. The new power-operated gangplanks (at top in photo above), mounted in pairs on turrets that roll back and forth along the pier, can telescope in and out, raise and lower. When not in use, they are swung against the side of the pier (as in drawing).



Radium Gauges Catalyst

ATOMIC rays from radium are keeping track of catalyst material in the Sun Oil refinery at Toledo, Ohio. Because of the heat—around 1,100°—and abrasive dust in the catalyst tanks, ordinary gauges can't tell how full the tanks are. But radium placed on one side of the tank can, since the number of rays reaching a Geiger counter on the other side depends on the amount of catalyst between the radium and the counter.

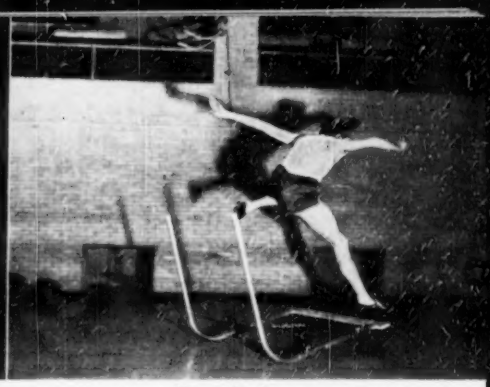
'Copters Save Lives in Korea

THESE action photos from the South Korean fighting front show the versatile helicopter in a new war role. Fitted with covered litter carriers, and able to land and take off where even grasshopper planes can't go, the 'copter emergency ambulances speed critically wounded GIs from mountainous forward areas to Army base hospitals.

1 Wounded soldier is eased into lower half of one of a pair of outrigger pods attached to helicopter. Built-in crosspieces near each end of the carrier support litter poles.

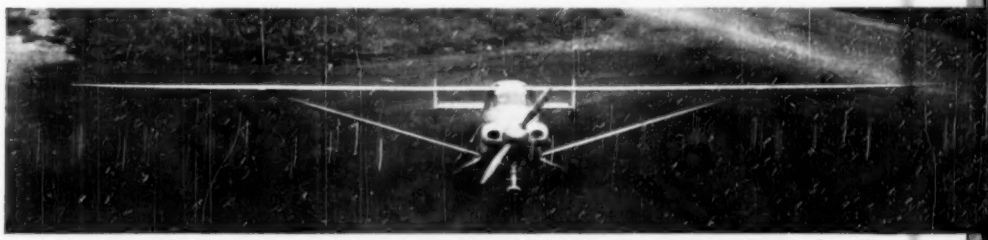
2 Cover goes into place to protect patient from wind and dust during hop to the hospital. The cover has plastic windows at both ends and slits to provide ventilation.

3 Flying ambulance takes off, balanced by a wounded man on each side. Helicopter evacuation is used only for most critical cases, where road trip might prove fatal.



Hurdle Prevents Track Spills

A NEW all-aluminum hurdle, being cleared at left above, was designed by John Marzucco, a high-school track coach at Ardmore, Pa., to prevent spills. If the crossbar is kicked, it doesn't rise to trip the runner, but tips over the entire unit, as shown above, at right. Telescoping sections permit adjustment to various heights.



Long Wing Gives Added Lift

LOWER wind resistance and higher load factor are claimed for the long wing—106 feet from tip to tip—on the experimental French plane above. Despite its length, wing surface is only 218 sq. ft. During trials at Orly Airport, near Paris, the 40-hp. Hurel-Dubois H-D 10 averaged 124 m.p.h., and reached an altitude of 15,000 feet.

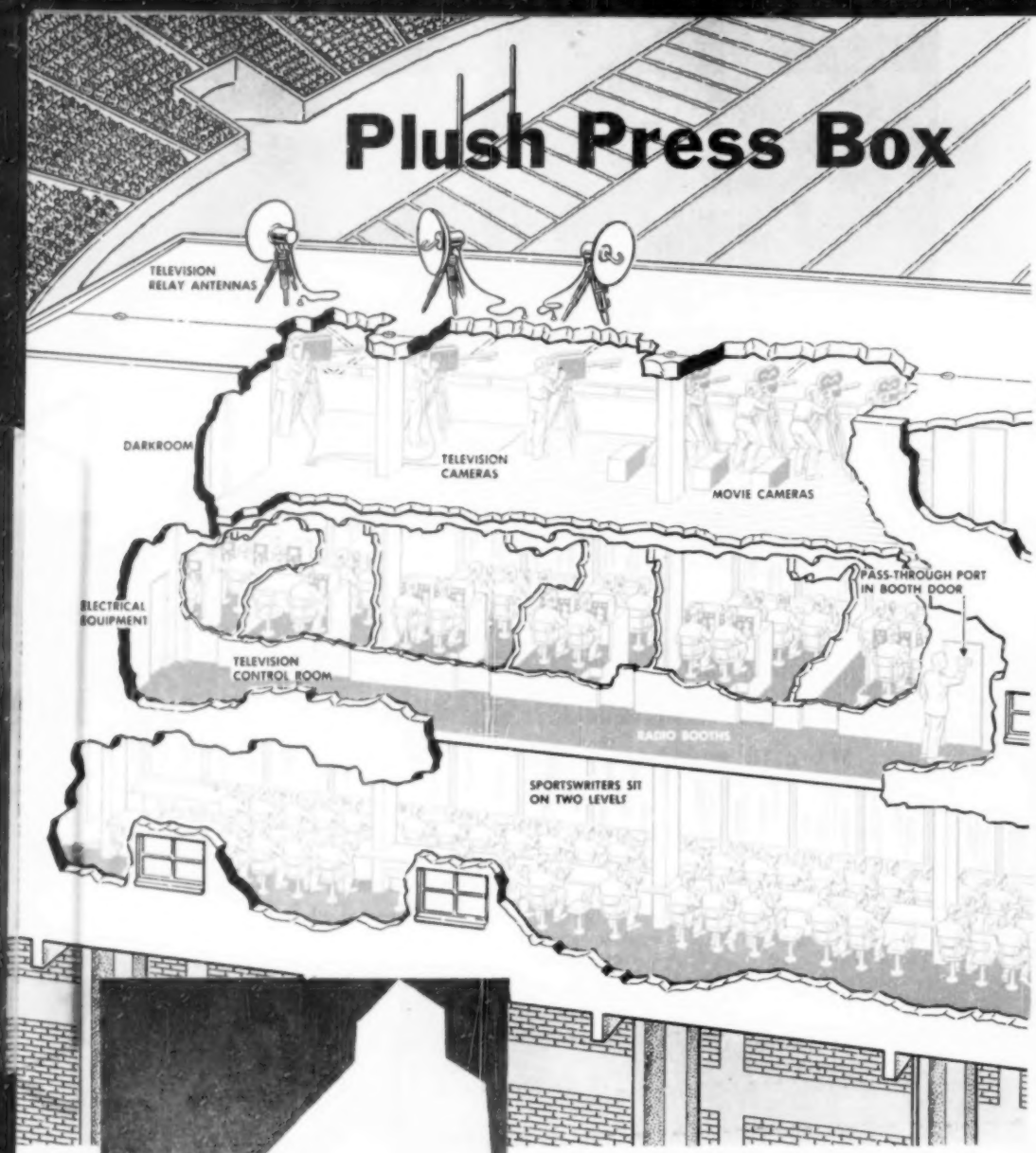
Sunshine Screened to Suit

THE bathing beauty below can adjust the screen behind her from complete shade (vertical position) to any degree of sunshine by tilting the frame. Aluminum louvers set closely together at a fixed angle in an aluminum frame screen sunlight but permit cooling breezes to blow through. Draper and Vaughn, Phoenix, Ariz., make it.

Photo Brush Is Radioactive

STATIC created when a camel's-hair brush is used on photographic negatives or slides attracts damaging dust. The Static Master brush below incorporates a coating of radioactive polonium, bonded to a metal-foil strip, that ionizes the air and bleeds off this troublesome static. Nuclear Products Co., Costa Mesa, Calif., makes it.

Plush Press Box

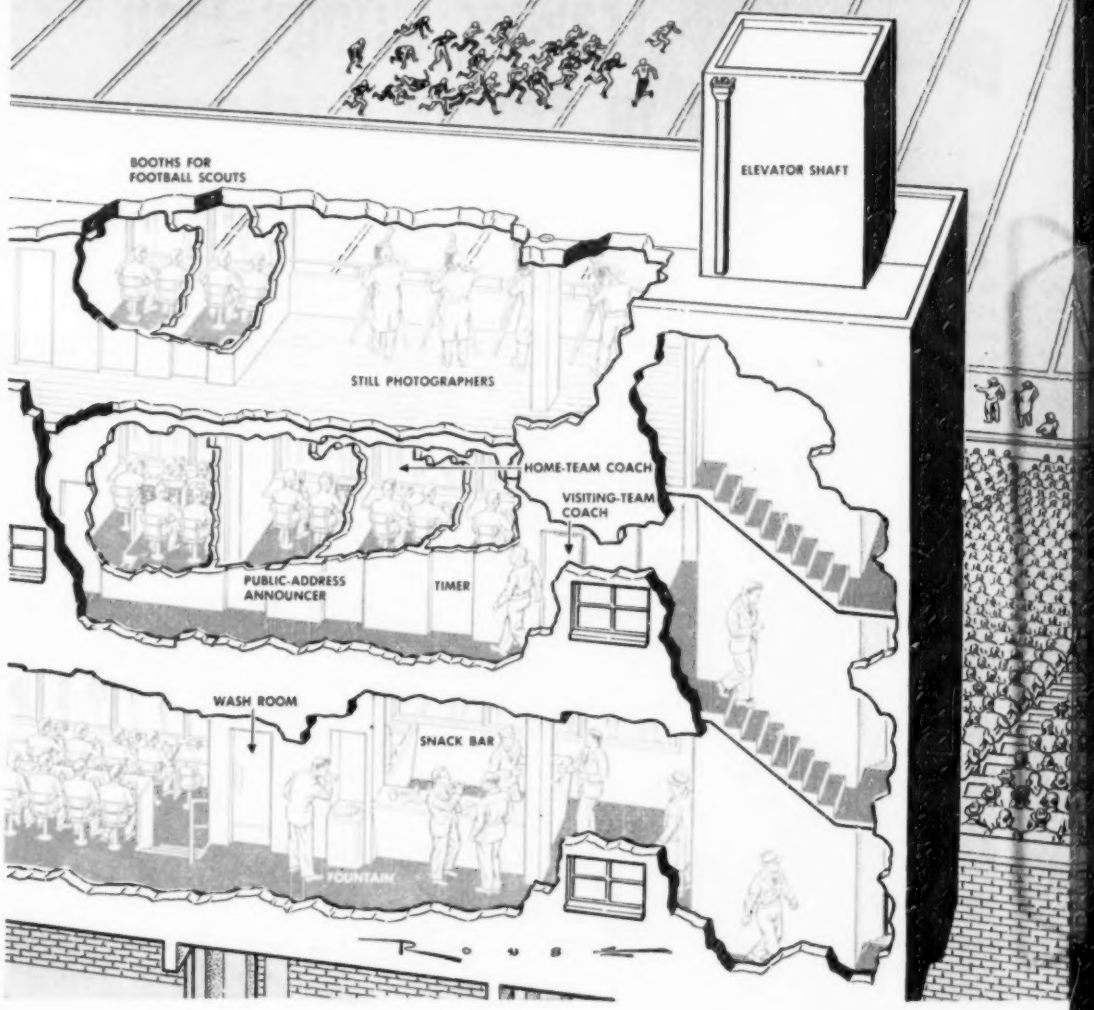


Oklahoma's de luxe press gallery has everything from snack bar to elevator to help newsmen cover fast action.

DRAWING BY STEWART ROUSE

THE only thing sportswriters lack in the new press box at the University of Oklahoma's stadium is a prepared-in-advance, play-by-play description of the game. Every other convenience to assist newspaper, ra-

for Football Reporters



dio, TV, and newsreel coverage is there.

The three-story structure—straddling the 50-yard line atop the stands 130 feet in the air—has its own private elevator, big enough to handle heavy camera and broadcasting equipment. For the writers, there are 65 seats on the first floor, all with an unobstructed view of the playing field. Most have built-in telegraph connections. Loudspeakers in the ceiling bring a play-by-play commentary from an announcer in telephone contact with two men on the playing field. An electric meter flashes the yardage gained by each team. Next door is a snack bar (hot barbecued turkey).

The second floor has seven radio booths and a television booth, all soundproofed, plus several booths for officials. The third floor is for cameramen—TV, newsreel, and still—with one side completely open. END

Trawler Brings Fish Home in Frozen Packages

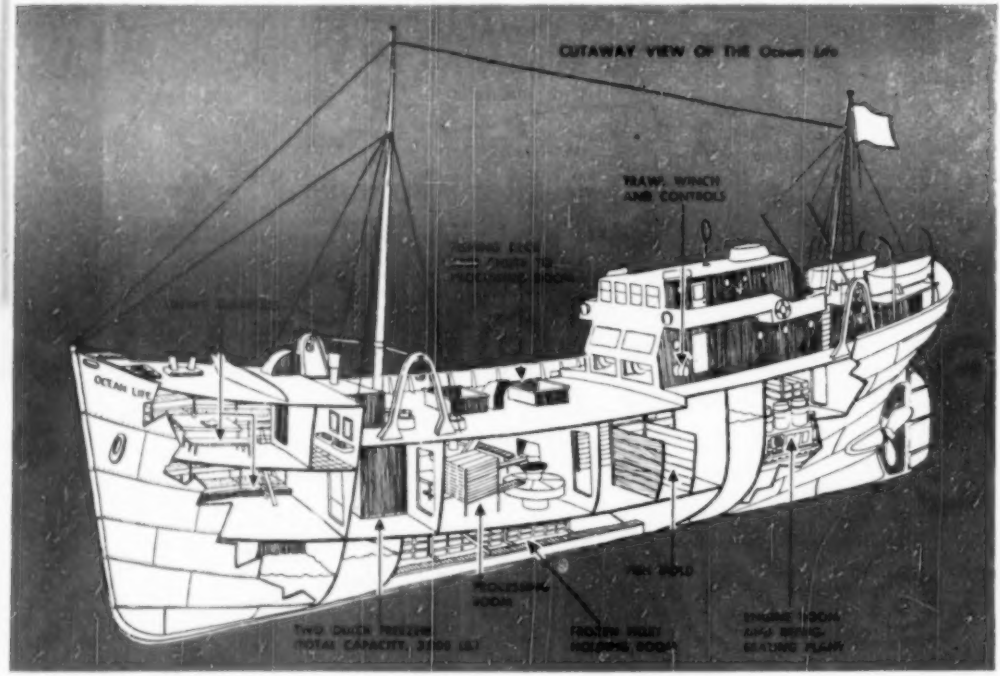
By Stephen Winship

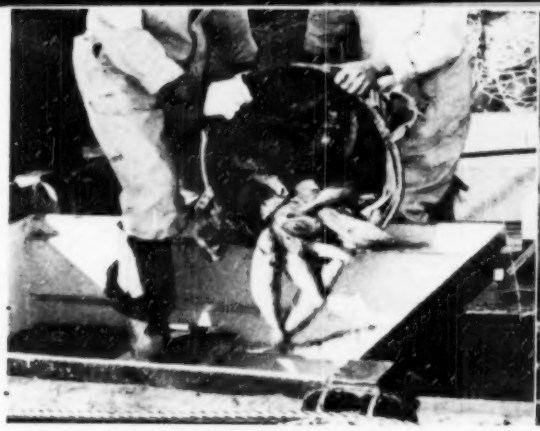
PHOTOS BY HARRY LIPPMAN

THE next package of frozen fish you buy may be literally right off the boat. Responsible for the innovation will be the 139-foot, 600-ton *Ocean Life* of Boston, first Atlantic Coast fishing vessel equipped to package and quick-freeze its catch at sea. A $225,000 conversion job has transformed a typical New England trawler into a nine-knot, Diesel-powered floating factory.

Cone-shaped 100-foot nets, dragged along the ocean floor, dump haddock, cod, redfish, sole, and flounder on the deck of the *Ocean Life* for sorting. Then the fish go down a chute to a 25-foot-square processing room, where two eight-man shifts turn them into fillets ready for the kitchen stove. Quick-frozen in a forty-below freezer, the packages are then stored in five-below coolers that can hold 250,000 pounds of fish.

Other trawlers preserve fish between layers of chipped ice, and must return to port before the catch spoils. Consequently, Yankee fishermen have been unable to stay at sea long enough for cruises to rich fishing banks off Canada and Newfoundland, or for capacity hauls along depleted New England banks. The *Ocean Life* may set a style for far-ranging new craft, operating more profitably and bringing back fish of better grade for American dinner tables.





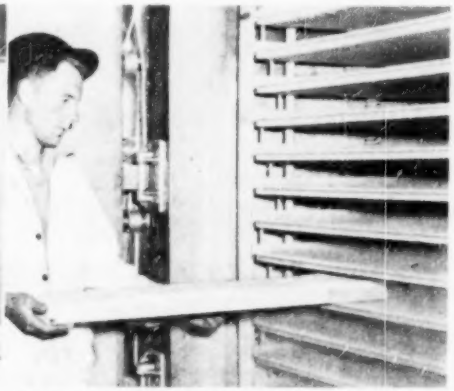
1 Down the chute to the processing room, from deck of *Ocean Life*, goes a basketful of fresh-caught haddock. How fish are turned into frozen fillets is seen in the following photos.

2 At bottom of chute, worker scales fish in a few seconds apiece with fast electric rotor, as above. Then he places fish on endless-belt conveyer, which takes them to filleting table.

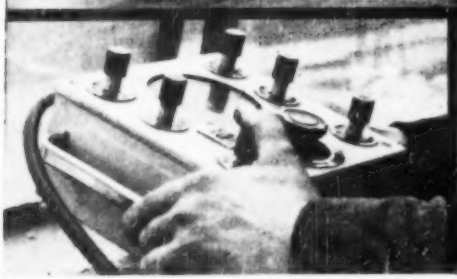
3 Delivery end of conveyer drops fish into bin at center of filleting table. Taking fish from bin, two workers strip meat from bone on cutting counters that form rim of the table.

4 Washed fillets ride this conveyer to a second circular table. There, five-pound batches are weighed out into revolving, "lazy-susan" receptacles in central part of table.

5 Turned halfway around, revolving center of table brings fish to packaging counter. Five-pound boxes of waxed cardboard are filled and placed on roller conveyer at lower right.



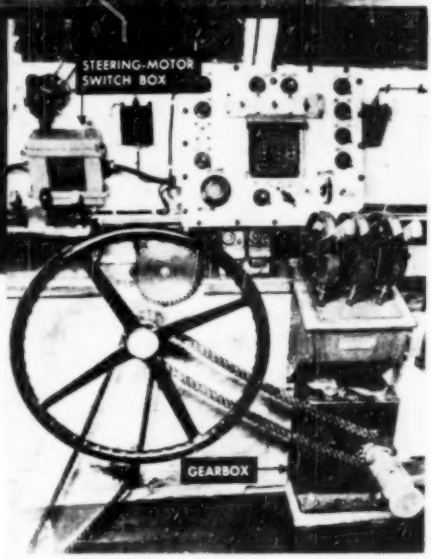
6 Metal tray holding four cardboard boxes goes into freezer. Quick-frozen, fish keeps as long as voyage lasts. Ship's product, ready for market, is seen at top of opposite page.



Without a man on board, RAF target launch (top) sails under control of push buttons on box.

Music Runs RAF Target Boat

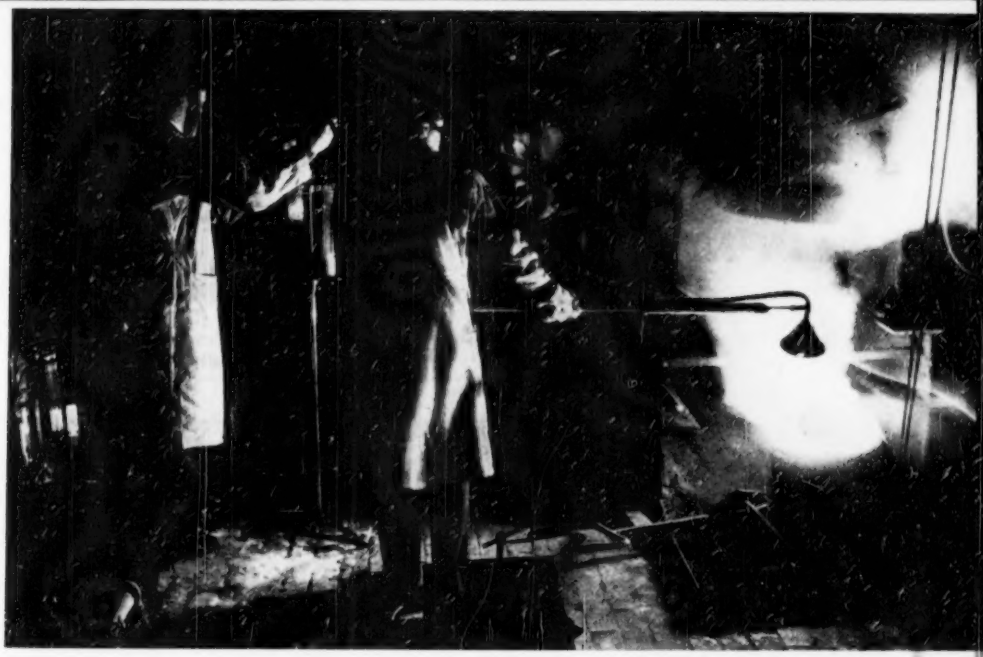
Music steers this new target boat for Royal Air Force bombers. It can cruise 19 hours without a man on board, controlled by musical "beeps" radioed from a mother ship. The signals, each of a distinct pitch, trigger devices that turn the wheel, adjust the throttle, start and stop the engines, and switch target lights on and off. A converted rescue launch, it is protected by 6½ tons of ½-inch armor plate on its deck.



Electro-mechanical devices adjust boat's standard controls, can be disconnected quickly to turn it back to ordinary, manned operation.

Big Sticks Boost Short-Wave Antennas 120 Feet Up

It takes long poles for short waves. These—each taller than a 10-story building—will support antennas for a private radio network of the Central Power and Light Co. at Corpus Christi, Texas. Three flatcars were needed to bring the wooden poles to the plant of the Koppers Co. (below), where they were treated with creosote.

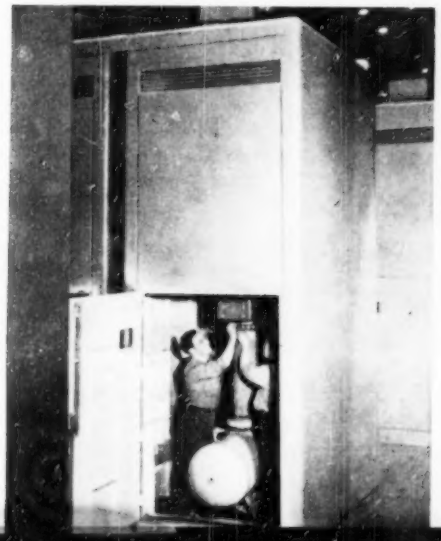


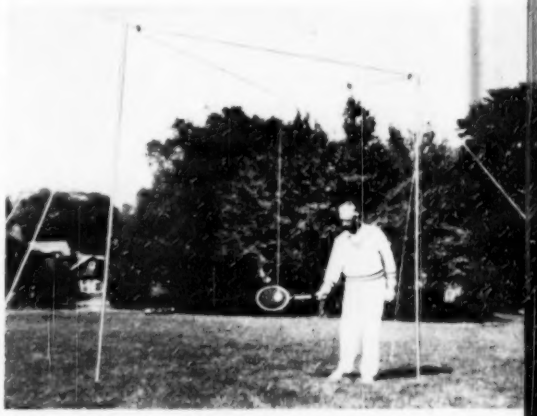
Hot Atoms Aid Steel Makers

A STEELMAKING test with radioactive tracers led to the dramatic scene above, at the Ford Motor Company. Wearing gloves and respirator for protection from radioactivity, an engineer collects vapor from a ladleful of molten steel with an inverted funnel. A vacuum pump draws the vapor into collecting bottles, in background at left, for tests to find out what happens to elements when high-quality steel is made.

Electric Switch 20 Feet High

NO MIDGETS are the workmen assembling the mighty electric switch pictured below. They're simply dwarfed by the size of the apparatus, a Westinghouse compressed-air circuit breaker being built for a New York City power company. Standing 20 feet high, it will be used to switch huge blocks of electric power on and off.



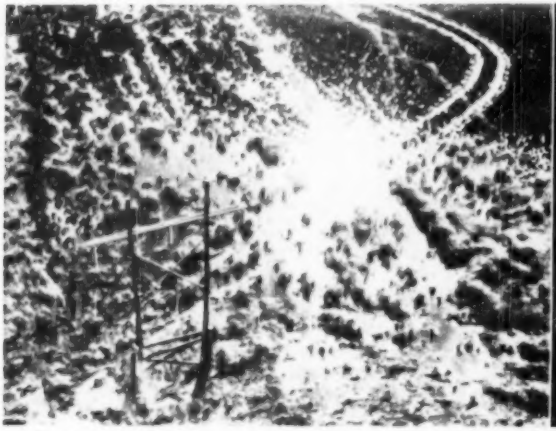


Training Aid for Tennis

SET up on lawn or beach, the Kum-Back Tennis Trainer, above, gives tennis fans the equivalent of a boxer's punching bag. By swinging at a tennis ball gyrating on a tether, a beginner can practice all kinds of strokes, and an expert can keep limber. And there's no waste footwork retrieving tennis balls batted off the lot.

Helicopter Firemen Put Out a Blaze

1 Making air patrol, above, of 115,000-volt power line, New Orleans Public Service engineer Leonard Ramon sighted a fire endangering line. Following photos show what happened.

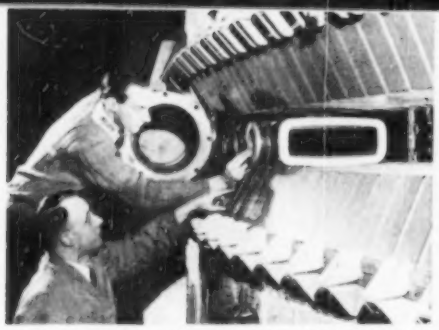


2 Close-up view from air at 3:06 p.m. showed Ramon that marsh-grass fire had set one wooden pole ablaze and was threatening others, in isolated region. Plane sped him to New Orleans airport and landed him there, to report, at 3:12.

3 From phone booth, Ramon at 3:16 transmitted report of the power-line fire and its location to headquarters of the power company.

4 While company dispatched line crew to try to get to fire by land, Ramon himself donned hip boots, grabbed extinguisher, and took off for scene in borrowed helicopter at 3:50.

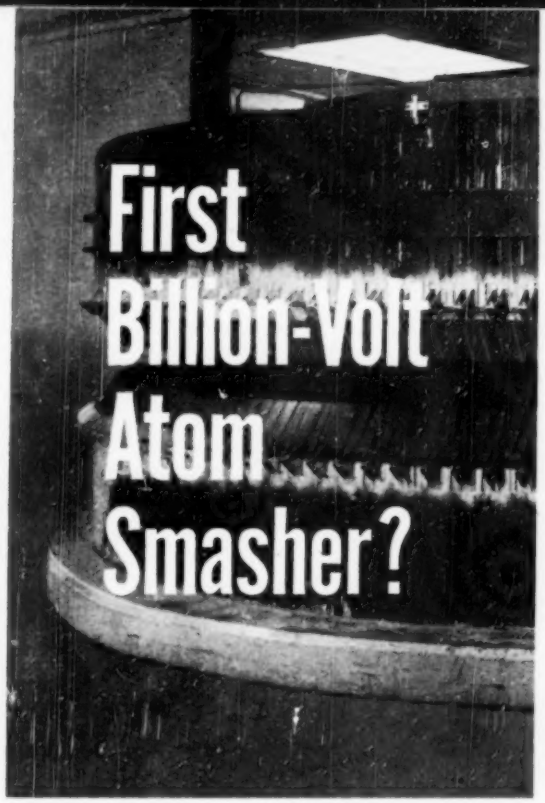
5 **First there at 3:58,** 'copter ferried in bucket brigade that put out fire. Story concluded next day when crew brought by swamp-crossing "marsh buggy" repaired burnt pole.



Section of "doughnut" tube through which atomic particles will race, showing oblong cross section, is installed between poles of magnet.

C-shaped plate being sprayed with paint is one of 2,400 similar pieces, half an inch thick, welded together to form laminated body of big magnet. Slot of "C" faces outward and encloses doughnut tube. Magnet's 1,100-volt power plant gives peak current of 12,500 amperes. It consists of two generators, a giant 37-ton flywheel, and a driving motor, all on one shaft.

First Billion-Volt Atom Smasher?



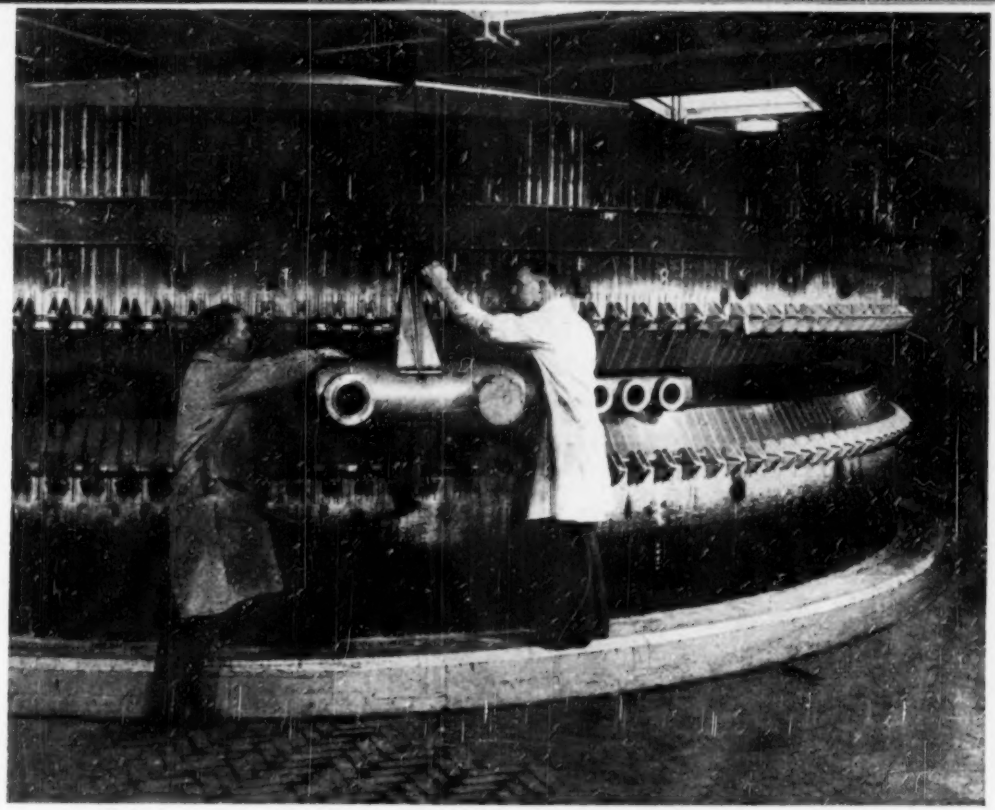
Ring-shaped magnet of 32-foot diameter,

A 1,300,000,000-electron-volt machine is England's entry in an international race to build the first billion-volt atom smasher. Designed by Prof. M. L. E. Oliphant, it is now nearing completion at the

Stop-go light on school bus turns red, halting all traffic while alighting children cross street. It is invention of Fred S. Martin, Chicago transit expert, who has patented it.

Traffic Light Put on Bus

School buses carry traffic lights in a safety scheme successfully tried out in Chicago. When a bus stops, it displays a red light visible from front and rear, halting all traffic until alighting children have crossed the street. Then a green light allows traffic to proceed. Amber and red lights together warn that a stop is about to be made. Operated by the driver with a dashboard control, the stop-go light has been found to be easily understood and promptly obeyed by motorists.

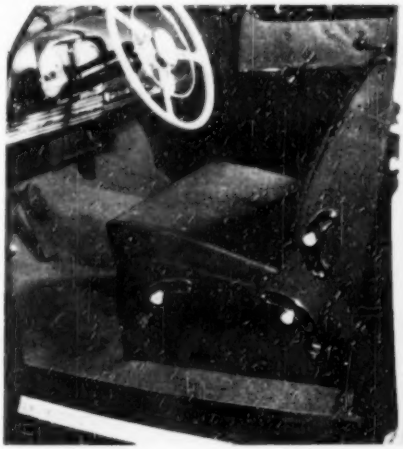


810-ton weight, gives layer-cake silhouette to England's billion-electron-volt atom smasher.

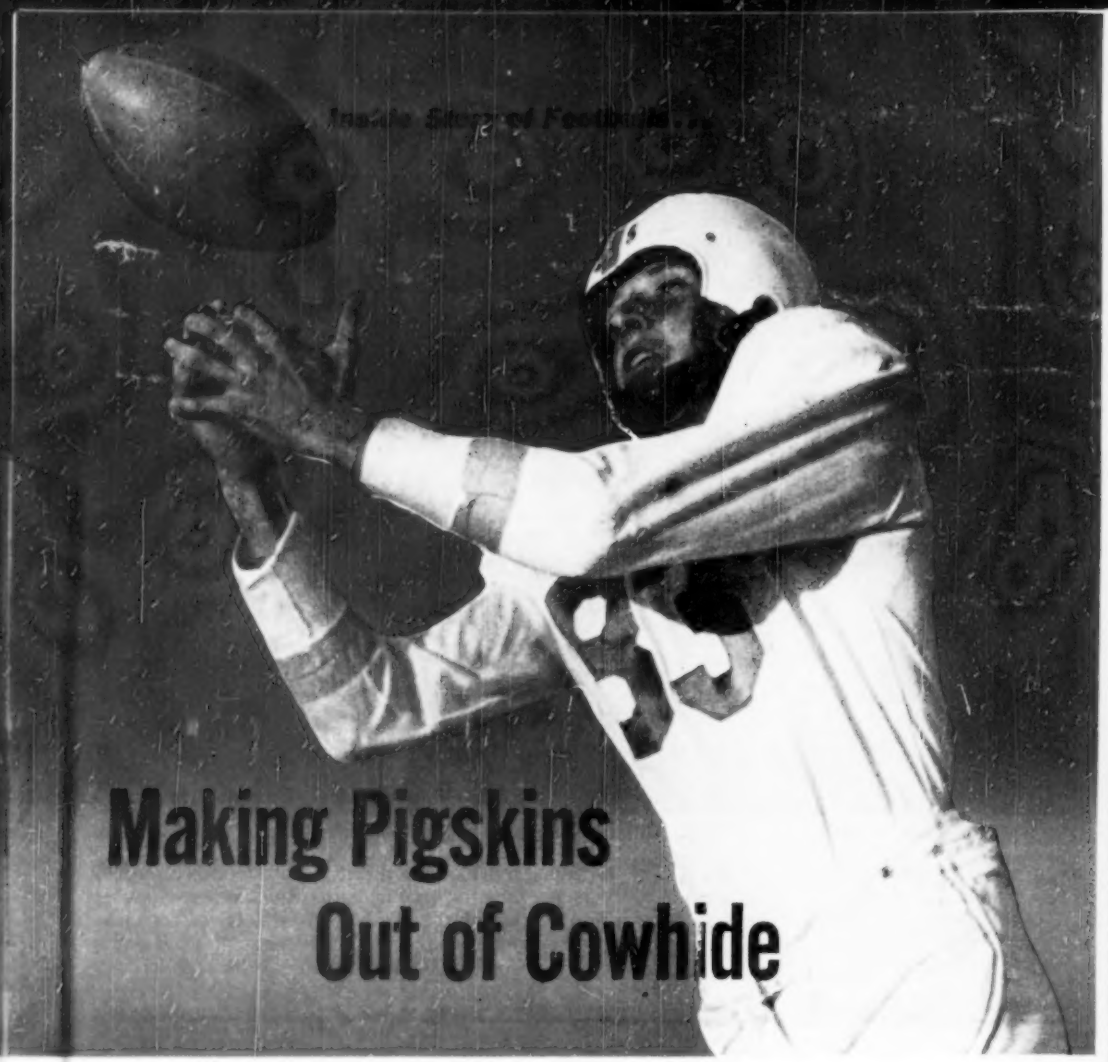
University of Birmingham. Soon it will propel atomic particles to enormous velocities in a "doughnut" vacuum tube within a 32-foot-diameter electromagnet. It is one of three proton synchrotrons expected to top the billion-volt mark. The others, building in America, are Brookhaven National Laboratory's 3,000,000,000-electron-volt cosmotron and the University of California's 6,000,000,000-electron-volt bevatron.

Cab Seat Fits 256 Drivers

VIRTUALLY anyone but a circus freak can make himself comfortable in the driver's seat of the new Checker taxicab. Four quick-acting knobs adjust the foam-rubber seat and back rest to 256 different positions, to suit the size, shape, and weight of any of a number of drivers who may operate the cab. Makeshifts such as bricks, boards, and pads to adapt a fixed seat aren't needed. By eliminating discomfort, the adjustable seat helps the man at the wheel to concentrate upon safe driving.



Driver's seat of new cab is quickly adjusted to fit its occupant with aid of four knobs, of which three are seen in picture at right. Fourth adjustment knob is at front of the seat.



Making Pigskins Out of Cowhide

By George H. Waltz, Jr.

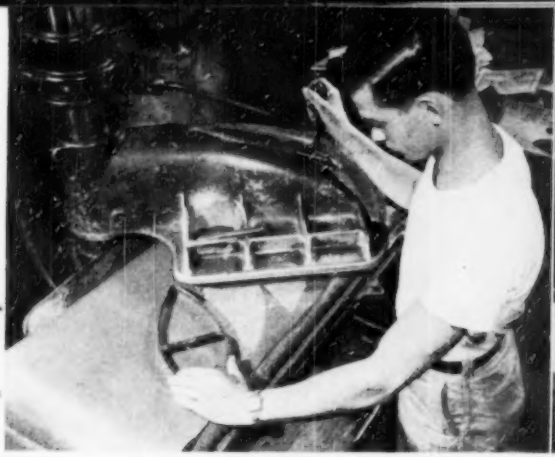
PS PHOTOS BY HUBERT LUCKETT

NOTHING takes a beating like a football. Kicked, thrown, squeezed, and pounced on from one end of the field to the other, it must have built-in ruggedness to take it.

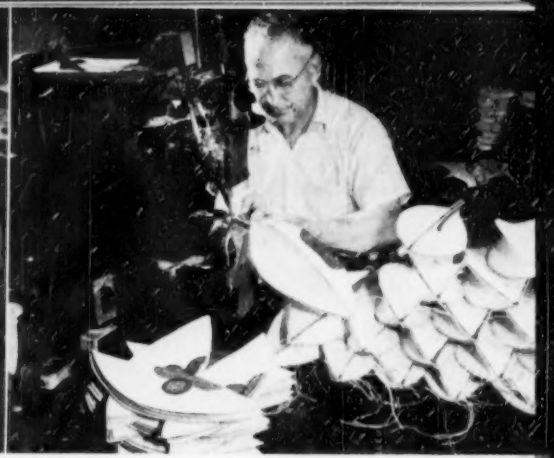
Just how tough a football can be was illustrated recently in the testing laboratories of the A. G. Spalding plant at Chicopee, Mass. One of their best balls, the J5-V, was placed in a large compression testing machine. When the ball finally burst, it had taken a squeeze of 24,500 pounds and been flattened from 6½ inches to half an inch.

Only the best parts of the best cowhides go into top-grade "pigskins." A ball must not only be rugged; it must also meet the rigid specifications set down in the football rule book. To be an official ball, it must weigh between 14 and 15 ounces and measure between 21¼ and 21½ inches around its girth and 28¾ to 28½ inches around its length when inflated to 13 pounds per square inch.

Although Spalding still makes about five times as many regular footballs for daytime use as they do white and yellow balls for night play, 1950 figures show that three times more night balls are being made this year than last—a fair indication of the growing popularity of football under lights.

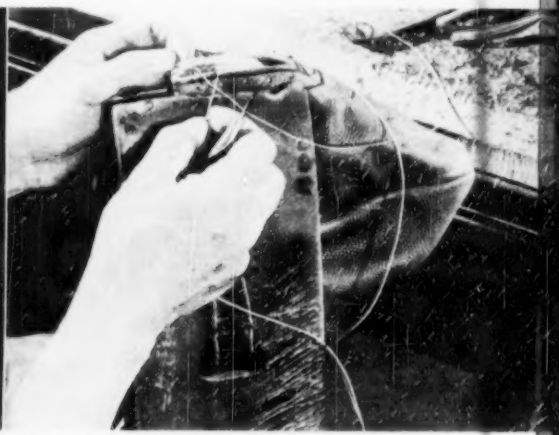


Best cowhide, carefully tanned and embossed to simulate pigskin, is used in making Spalding's best footballs. The leather panels are cut with a die in a machine called a "clicker."



Footballs are made inside out. Four leather panels, each backed with a fabric sandwich of twill and drill cemented together, are lock-stitched on a power sewing machine.

After stitching, ball is turned right side out through lace opening. This is done by carefully working the cover down over a smooth wooden stake. It takes strong hands and patience.



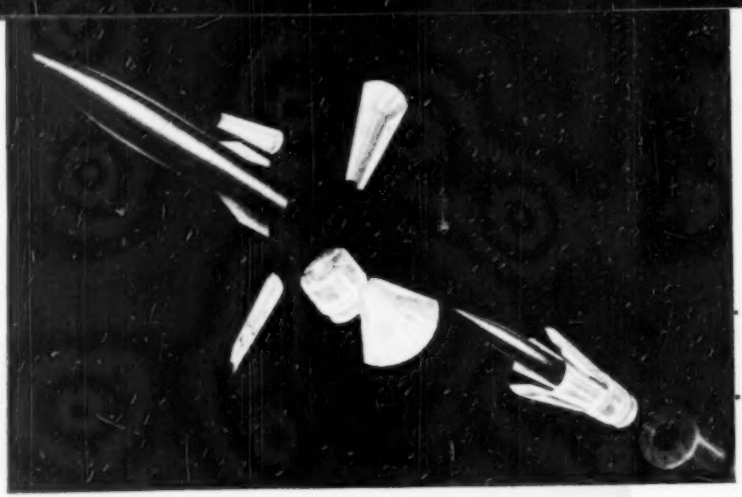
Hand finishing. To allow the cover to be turned right side out, the lace opening is left larger than necessary during the machine stitching. This portion is stitched by hand.

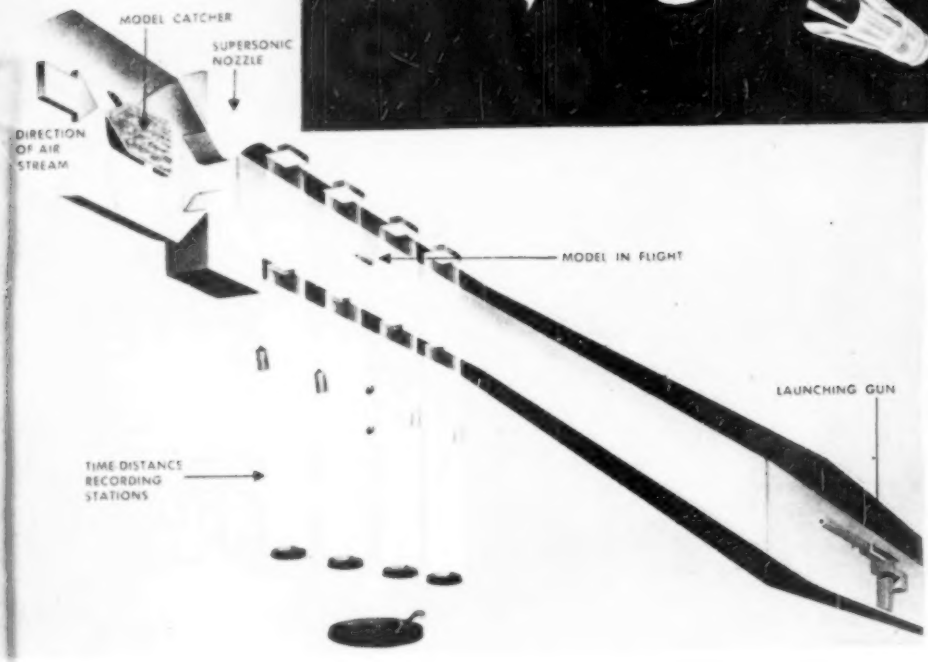
Leather lacing is placed after bladder and its valve have been inserted. Bladder, cover, and lacing have been weighed to make sure ball will come within 14- to 15-oz. weight limits.

Final inspection includes nipping off the end of the rubber valve and checking the ball's girth and lengthwise circumference against the official rule-book specifications.

How "sabot" carrier for model missile is broken up by air stream, leaving model to fly alone, is shown in drawing at right.

Complex photographic rig, sketched in cutaway below, records times of flights of missiles tested in "shooting gallery."





Guns Shoot Tiny Models

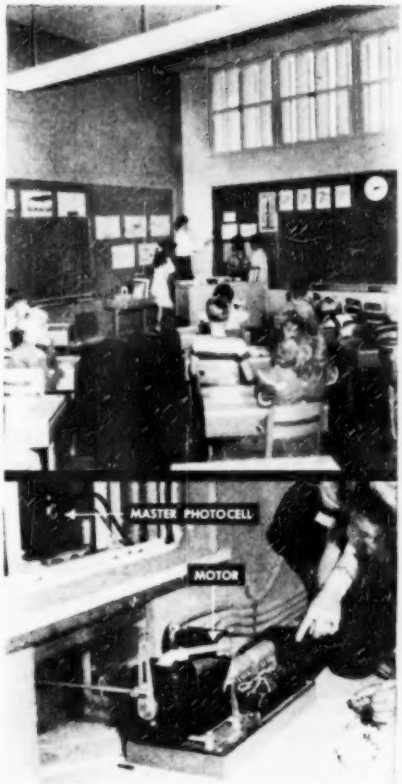
BY SHOOTING tiny rocket models out of a gun, scientists of the National Advisory Committee for Aeronautics are learning how big missiles act in supersonic flight many miles up. The NACA's shooting gallery is actually a new kind of wind tunnel. A pressure tank blows air into the tunnel at several times the speed of sound. Into the teeth of this gale, the carefully proportioned models are fired from a gun, traveling only 65 feet before they smash into a container.

The guns used range from .22-caliber sporting rifles to three-inch cannon. When being fired, the model itself is encased in a carrier made of nylon or Lucite plastic that just fits the gun barrel. This carrier, called a "sabot," breaks up and falls away as soon as it leaves the gun muzzle. Thus the missile makes its test ride alone.

During the brief flight—it lasts only about 1/100 of a second—four still pictures and a movie record are made. The missile trips photoelectric cells that fire very short, powerful flashes, making shadow photographs. Simultaneously, a complicated system of mirrors and prisms reflects the flashes to a rotating circle of 35-mm. movie film, establishing the time the shadow pictures were taken. Scientists study the photographs to get data on lift, drag, and other factors.

Stabilizing fins of model rocket fit into slots of clear-plastic jacket, or sabot. The sabot protects model while inside gun barrel, also acts as piston to prevent escape of gases until model leaves gun. It falls clear of missile within first five feet of travel down the range.

Among the guns used to fire the models is this .50-caliber machine gun. It is shown mounted on a three-inch cannon, which is kept lined up by side spring. Models have also been shot from .22-caliber rifle and 20-mm. and 37-mm. cannon. They sometimes hit 3,600 m.p.h.



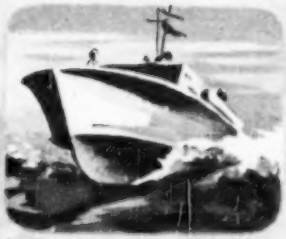
Individual room control lets teacher close louvers (near ceiling in top photo) to darken room for movies. Ordinarily, single master control (bottom) adjusts light in all rooms.

Electric Eye Adjusts Blinds

THE sun controls itself to provide even lighting in classrooms of the new Will Rogers school in Ventura, Calif.

A photoelectric cell responding to the amount of sunlight striking it turns the trick. Through a series of relays and electric motors, the output of the photocell automatically opens or closes vertical louvers shading the windows of all the 11 rooms in the school.

Each room also has an individual control so that the teacher can disconnect the master system and close the blinds for showing movies. The installation was developed by Minneapolis-Honeywell.



Small, high-speed naval craft may use propellers of titanium. Other future and present uses are shown on next page.

TITANIUM: Our Next Major Metal?

By Harland Manchester

PS DRAWINGS BY RAY PIOCH

A new rival challenges aluminum and steel as a structural material for airplanes and rockets, guns and armor, and vehicles of land and sea.

Biggest military use of titanium to date has been for smoke screens, made with liquid titanium tetrachloride. This compound now can be converted into strong and lightweight titanium metal, for which important future military applications on land, at sea, and in the air are forecast.

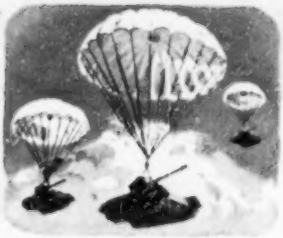
A FEW years ago Dr. Charles H. Moore, Jr., a young industrial research scientist of Perth Amboy, N. J., made in a small furnace of his own design a pear-shaped crystal of titanium oxide the size of his thumb. He was working with titanium to try to make white paint a little whiter—and eventually he succeeded. But as he looked at the crystal he got another idea. He took it to a lapidary, who cut and polished it. The result was an amazingly beautiful gem, not quite as hard as a diamond but far more brilliant.

Thus the first really new gem in history was born. There are synthetic rubies, emeralds, and the like, but titania, or rutile, is not an imitation of anything. It is a gem in its own right. National Lead Company, Dr. Moore's employer, operates six furnaces to make the crystals and sells them to gem cutters all over the country. Thousands of women are proudly displaying them. Most titania stones are almost white, but they are also made in rich blue, brown, red, green, and yellow. They sell for about one thirtieth of the price of diamonds.

This new gem is only one facet of the great titanium development which many scientists, manufacturers, military men, and investors are excited about. Titanium, light, strong, and rust-resistant, will, they predict,

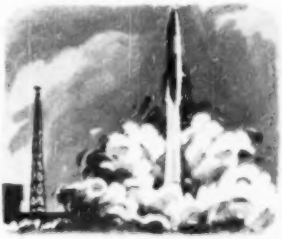
First large-scale use of titanium metal may be for warplane fuselages. Sheet metal offers advantages over aluminum.

Portable bridges of titanium interest Army engineers. Metal could be used for girders and other structural members.



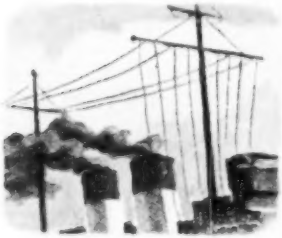
Airborne tanks and artillery can be made lighter without sacrificing strength by substituting titanium for steel.

Titanium armor plate around cockpit of fighting plane is possible application reported under study by Air Force.

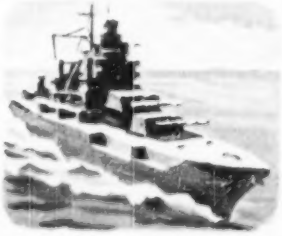


Rockets and guided missiles may employ skin of titanium to resist heat of air friction at supersonic speeds.

Lightweight body armor of titanium may be worn for protection against bullets by some troops of future armies.

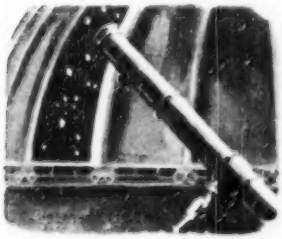


Wire for radio aerials is one of many shipboard uses foreseen for titanium because it resists salt-spray corrosion.



Warships' metal decks would need no paint, and cables would be rustless, if made of silvery new titanium metal.

Making entire hulls of vessels from titanium may be a long way off, but seaplane floats are one immediate possibility.



Small but powerful telescopes may employ lenses of transparent titania, the same material recently introduced as a gem.

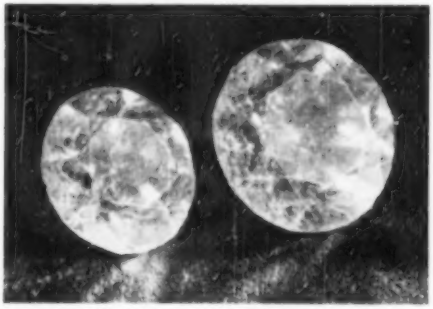
Most familiar use of titanium is as titanium oxide pigment to make whitest of white paint, and white-sidewall auto tires.

Smaller periscope tubes, made possible by light-gathering power of titania lenses, would be harder for enemy to detect.

Titanium metal now comes in ingots up to 450-pound size of the one above. Du Pont makes the big ingots by melting sponge titanium in an electric furnace, in atmosphere of argon gas.

be our next major metal, rivaling in importance aluminum, magnesium, and stainless steel.

Better and faster planes, more powerful jet engines and gas turbines, lighter and more durable automobile engines, ships that need no paint, long-wearing and nonrusting surgical instruments and other edged tools, cool handles for kitchen pots and pans, better optical lenses—these are a few of the things that titanium in its various forms may bring about.



Gems cut from new material, transparent and crystalline titania, outshine diamonds and cost only 1/30 as much. Most are almost white; other are blue, brown, red, green, and yellow.

Titanium may find its first big use as sheet metal for airplane skins. With supersonic speeds, the friction of air sweeping over the wings and along the fuselage rapidly heats the thin metal covering. At high temperatures, aluminum alloys get brittle and buckle. Stainless steel will stand the heat, but adds too much weight. The new metal may bridge the gap between aluminum and steel. It is strong and elastic up to about 800°F., and scientists are working on alloys expected to behave well at 1,000° or more. Sheet titanium also seems slated for covering rockets and guided missiles—and space ships, if they become a reality.

Titanium is a natural for airborne vehicles and weapons. Its use instead of steel cuts weight 40 percent with no sacrifice in strength. Army Ordnance is testing the new metal for tanks, and finds that half-inch titanium plate resists penetration better than alloy steel of the same thickness. Artillery can be made lighter and easier to handle by the use of titanium. Lightweight body armor for troops is a definite possibility.

Maybe a No-Paint Navy?

If the Navy has its way, it will get the lion's share of titanium as soon as it becomes commercially available. Not only will 60 pounds of this silvery metal do the job of 100 pounds of steel, but it is virtually rustproof. Numerous salt-water tests held off the coast of North Carolina show that it resists corrosion better than stainless steel, Monel metal, or alloys of nickel and chromium. Samples of titanium immersed in the sea for 60 days showed no trace of corrosion—a record equal to that of platinum, which is metals' noncorroding champion. The prospect of decks that need no paint, and of cables and other sea-going gear that never rust, is tempting to naval men.

Titanium is also unaffected by many highly corrosive acids and alkalis, and its resistance to vinegar, citrus juices, and other corrosive foods makes it eligible for containers and pipes in food-processing plants and kitchens.

Titanium has the great merit of being plentiful. It is the ninth most common element in the earth's crust, far more plentiful than nickel, copper, or lead, and it is the fourth most abundant structural metal, exceeded only by aluminum, iron, and magnesium. This does not mean that our factories can start using the metal tomorrow. Production is yet in the pilot-plant stage,

the cost is high, and the techniques of refining the metal and fabricating bars and sheets in quantity are not yet perfected.

But in scores of government, university, and industrial laboratories from coast to coast, a concentrated drive is under way to harness this versatile and long-neglected element. In the last four years, Government and industry have spent more than 15 million dollars on titanium research, and belief is common among experts that it will become a major structural material within five or ten years.

Found by a Clergyman

Titanium is by no means new. The ore was first discovered about 160 years ago by an English clergyman and amateur chemist, William Gregor, when he noticed a curious black sand resembling gunpowder on the banks of a brook and tested a sample. Martin Heinrich Klaproth, famous as the discoverer of uranium and other elements, read his report and rediscovered titanium in an iron-bearing ore called ilmenite. Klaproth announced it as a new element and gave it its name. He tried to isolate it but failed, and it was not until 1910 that the metal was produced in a laboratory.

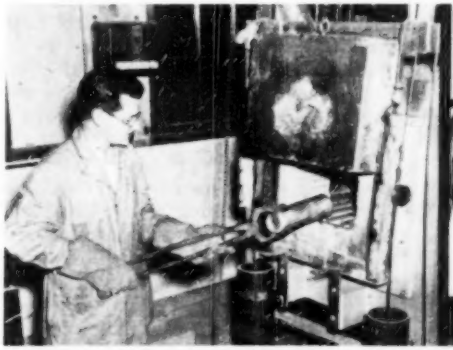
The first big-scale use of titanium developed indirectly from the fact that a bearded French chemist named Auguste J. Rossi was something of a gourmet. He was employed in the laboratory of the Titanium Pigment Corporation, Niagara Falls, N. Y., which produced titanium oxide to improve the whiteness of false teeth, billiard balls, and other articles. He always brought his lunch to the laboratory and there mixed his own salad dressing. One day in 1908, he spilled some olive oil on his workbench. Noticing how it mixed with the titanium oxide, he began research into the possible use of the oxide as a paint pigment.

The result, many years later, was the whitest white paint ever known. The tiny crystals are highly efficient reflectors of light, hence titanium paint has great opacity, or "hiding power." This means that a little of it will cover a lot of surface. A dash of titanium oxide is used by the Johns-Manville Corporation in the manufacture of a long-lasting white asbestos-cement siding for houses.

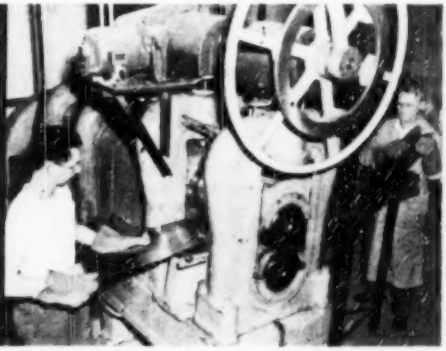
Titanium oxide has greatly supplemented white lead in paint. It is also used in white-wall tires, white rubber bathing caps, kitchen-equipment enamels, opaque glass, pottery, linoleum, white cellophane wrappers, and face powders and creams. It is used in rayon to make it more opaque. Because it makes paper more opaque, thinner sheets can be used without the printing showing through, so that Bibles, dictionaries, catalogues, and the like can be made much less bulky. Some 225,000 tons of titanium oxide are now used every year to make white things whiter.

Looks Like Clinkers

Dr. Wilhelm Kroll of Luxembourg, one of the world's leading authorities on titanium, 18 years ago invented a promising process for extracting the pure metal from the ore. To escape the Nazis, he fled to the United States in 1940. The Bureau of Mines, which was already adapting Kroll's method for large-scale production, signed him up. A

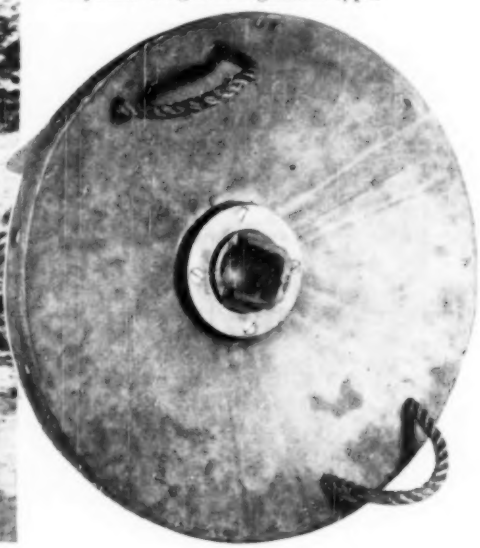


Hot titanium ingot is withdrawn from furnace for forging and rolling, in Remington Arms plant's laboratory at Bridgeport, Conn. Experts here are pioneering in developing uses.



Sheet titanium, above, is produced on experimental scale by miniature rolling mill in Remington Arms laboratory. Experimenters are seeking best methods for making sheet and rods.

Shell-throwing 81-mm. mortar, seen at left in action in Korea, is potent weapon with big asset of portability. Experimental base plate for mortar, below, made of titanium, weighs only 25 pounds, notable improvement over 45-pound weight of regulation type.



pilot plant was set up at Boulder City, Nev., and by 1946 the Bureau was making the new metal in usable amounts. It was spongy gray stuff that looked like over-size furnace clinkers.

The Bureau set up another pilot plant at its College Park, Md., station, to fabricate the metal into bars and sheets and to work on alloys. Samples were sent to various industries and research laboratories, and enthusiasm began to snowball. Du Pont and the National Lead Company plunged into research and began pilot-plant production.

Three Steps in Making It

Winning titanium metal from ilmenite ore, a compound of iron, titanium, and oxygen, takes three principal steps. The first yields titanium tetrachloride, often used for military smoke screens because it forms dense white fumes in contact with moisture in the air. It is a colorless (when pure) to reddish-yellow liquid of powerful acrid odor, with a boiling point only slightly higher than that of water, and is obtained by treating ilmenite with carbon and chlorine.

Titanium metal itself, in spongy form, is produced by the next step. In the Kroll-Bureau of Mines process, this consists of adding the liquid tetrachloride to heated magnesium metal in a tightly closed reaction chamber or "bomb." Magnesium chloride and pure titanium result. This sponge titanium is then ground to powder.

Final step is forming the titanium powder into solid ingots, to be rolled into sheet or formed into bars. Du Pont does it by melting the powder in an electric furnace containing an inert gas, argon, and has thus produced titanium ingots weighing up to 450 pounds apiece. Continuous production employing an electric furnace is under experimental development at the Battelle Memorial Institute.

Powder metallurgy offers an alternate method of making ingots from titanium powder, without melting it, by heat and pressure. And it contributes a novel process called sheath rolling, developed by the Bureau of Mines, for transforming titanium powder directly into sheet metal. Like sausage meat in a casing, the titanium powder is packed into a welded sheath of another metal, such as steel. The whole combination is heated and rolled. Then the sides and ends of the flattened sheath are cut.

The sheath is readily stripped off, and sheet titanium remains!

When the Bureau of Mines began to work on titanium, world production of the metal ran about 10 pounds a year. Today total U. S. production is in the neighborhood of 40 tons a year—enough for large-scale experiments. Having nursed the new metal to the toddling stage, the Bureau is now turning it over to industry.

Discovery of superior new titanium alloys will hasten its adoption. The pure metal is sensationally strong and stable up to 800°F. Tests indicate that the right alloys will push this ceiling far higher, and work is going ahead rapidly. The Battelle Memorial Institute has already investigated 400 combinations, and there are literally hundreds of thousands of possible recipes.

Bigger Payload Aloft

When the right alloys become available in large amounts, aviation experts foresee a possible 20-percent reduction in the weight of airplanes, which would more than double the plane's load of freight, fuel, or bombs.

When titanium was used only for pigments, we got most of it from the black sand beaches at the southern tip of India; now geologists report such widespread distribution of the ore throughout North America that we can be completely independent of imports.

From a huge, terraced, open-strip mine at Tahawus, N. Y., titanium-bearing ilmenite is being scooped up by the National Lead Company. The Kennecott Copper and New Jersey Zinc companies are jointly spending 25 million dollars to open up a tremendous ilmenite deposit in the Allard Lake region of Quebec, and du Pont and other firms are getting titanium from Florida beaches.

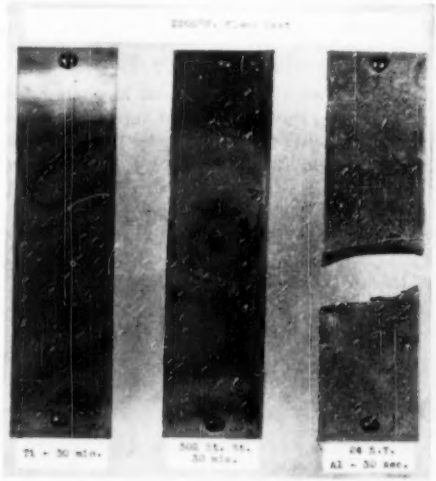
There are other deposits in Virginia, Arkansas, Oregon, Idaho, and in the deltas of the Columbia River and the Rio Grande. Dr. O. C. Ralston of the Bureau of Mines predicts that domestic deposits now being developed should last at least a century, even with greatly expanded use.

The price of the new metal during the teething period is, of course, too high for large-scale use. Sponge titanium costs $5 a pound. This price is expected to dip to $1.50 before very long. Dr. Ralston believes that when the development work is over and plants turn it out by the ton, it is reasonable to expect a production cost of 50 cents a pound. Manufacturers point to the history of aluminum, which in some 70 years dropped from $90 to 15 cents a pound, and magnesium, which since 1915 has dropped from $5 to as low as 20½ cents a pound.

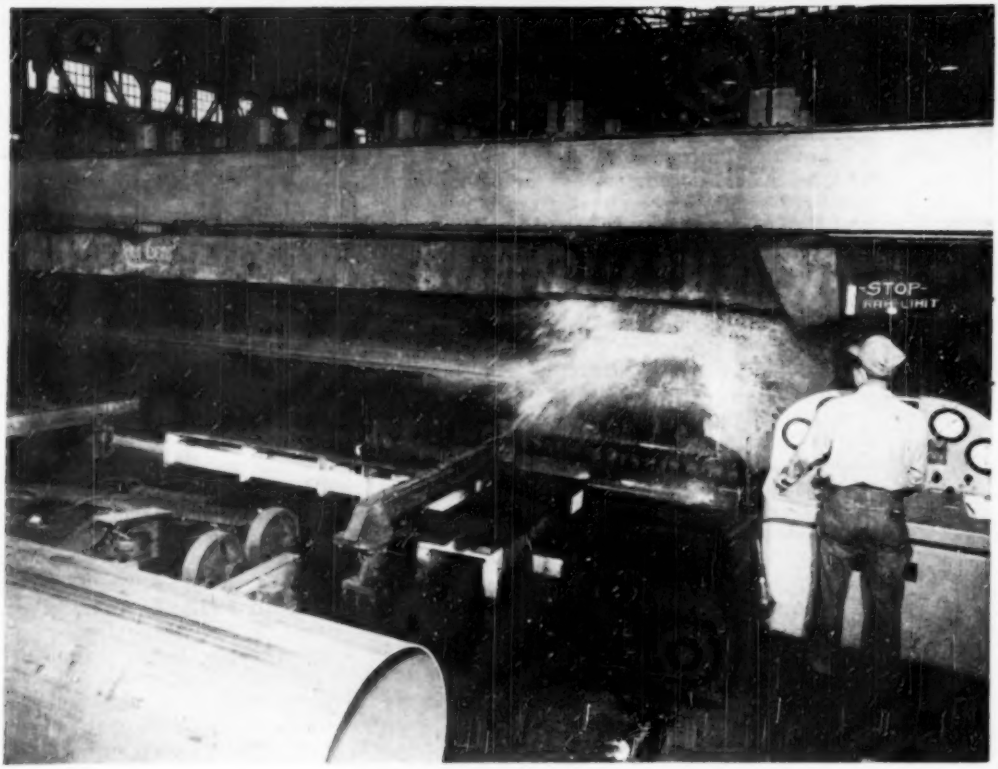
As for titania, the gem with more fire than a diamond, its fascinating possibilities are not limited to the decoration of digits. Because of its superior light-gathering ability, Dr. Moore believes that it has important optical uses. As bigger crystals of optical purity are made, titania lenses might make possible powerful small telescopes, smaller periscope tubes, smaller tubes for internal physical examinations.

A research job in this field has been launched by Bausch and Lomb. The crystals also have interesting electrical properties that are being explored by the Bureau of Standards. Tiny wafers of barium titanate are used in place of crystals in hearing aids, radios, radar, TV, and record players.

In a few years, a man may ride in a titanium plane, drive a car with noncorroding titanium pistons, use a refrigerator with rustless titanium shelves, carry a titanium watch, read with titanium glasses, wear a titanium gem, and listen to a wrist-watch radio with titanium parts. Whatever other uses may be found for the new metal, you may be sure there is titanium in your future. END



Comparative tests in Remington Arms laboratory show that heat-resisting titanium, left, withstands 2,200° F. flame better than does stainless steel, center, or aluminum alloy, right.



Water Stretches Pipe to Size

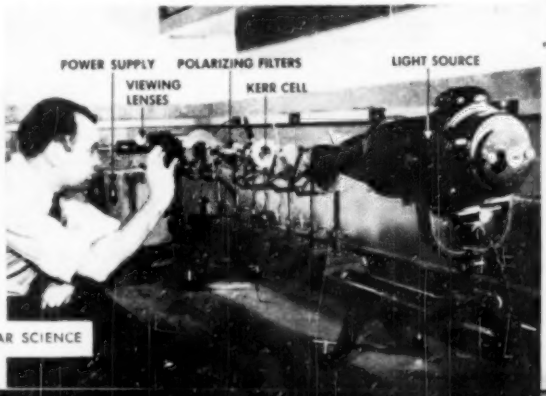
To make heavy steel pipes exactly the right size, this National Tube Co. mill stretches them with water. The electrically welded, two- to three-ton steel tubes are placed in a die to limit expansion, and the ends are plugged. Three pumps then force water into the pipe at pressures as high as 3,000 pounds per square inch. This tremendous pressure expands the pipes—some having walls ½ inch thick—as much as ½ inch.

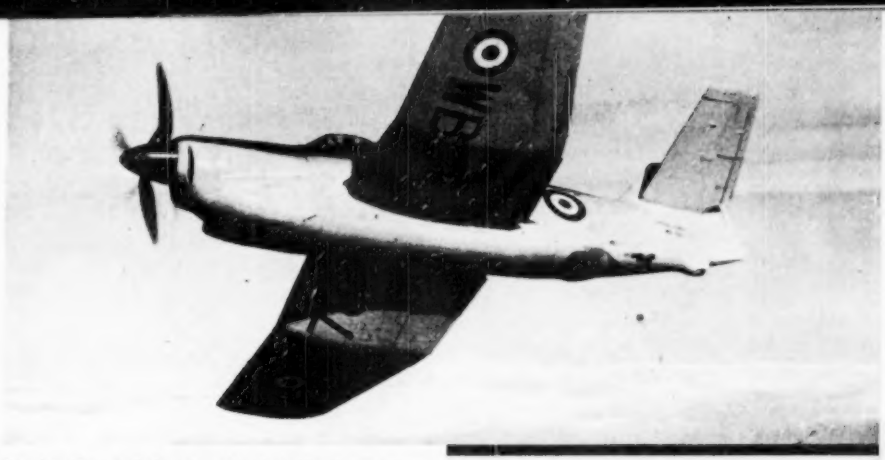
Welt Seals Fenders Fast

Win Martin got tired of loosening fenders every time he had to replace the seal between fender and body. So he invented a new kind having metal clips (arrow, below) that can be driven into place with a hammer and a wood block. The seal is made of paper cord and cloth impregnated with rubber. Quick-Trim is made by the Martin Quick-Trim Co., of Los Angeles.

Color Maker Aids TV

Color-television research is being helped by the unusual color maker shown below. It uses a series of polarizing filters and a Kerr cell—a glass container filled with nitrobenzene—that changes the polarization of light when a high-voltage electric current is applied to it. Westinghouse scientists vary the color of light from the lamp by raising and lowering the voltage.





Britain Adds Aerial Subchasers

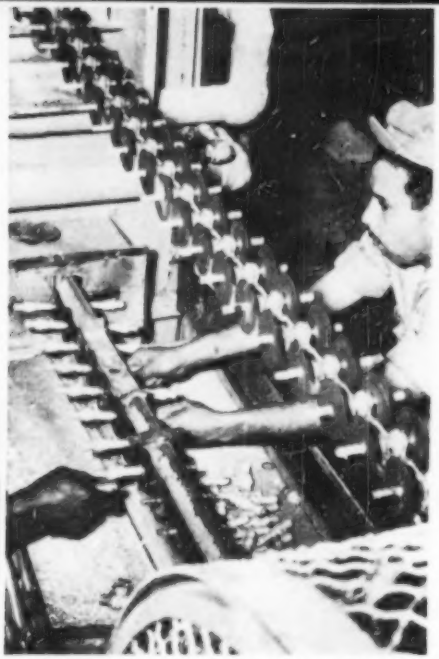
THESE two new planes being added to Great Britain's fighting forces are especially designed for antisubmarine warfare. Shown banking on a turn above is a Y.A. 5, which, despite a huge bomb bay and retractable radar dome, shows extremely clean lines. At right is a Fairey 17, made to be stored aboard aircraft carriers in great numbers. It's powered by a Mamba twin-turbine engine with contrarotating, coaxial propellers. Wings measure 54 feet 4 inches, but can be folded down to less than 20 feet.

Mason's "Gun" Cuts Waste

THE mason below is applying mortar to a hollow cement block without wasting a drop. He's using an electrically operated mortar gun, said to be three times faster than a hand trowel. A motor turns a worm conveyer, pushing mortar out through a nozzle. It's priced at $89.50 by Vita Labor Saving Tools, Smithtown Branch, N. Y.

Windshield Wax Repels Rain

IN THE photo below you are looking through a plane windshield being hose-sprayed to simulate rain. The right-hand section, with visibility unaffected, has been treated with FC-10, a new rain-repellent wax. Vision through the untreated side is cut completely. National Research Council of Canada developed the wax.



1 **These used spark plugs** will be good as new after their 10-minute trip through the Air Force's reconditioning plant. Here they are inspected after cleaning, degreasing processes.

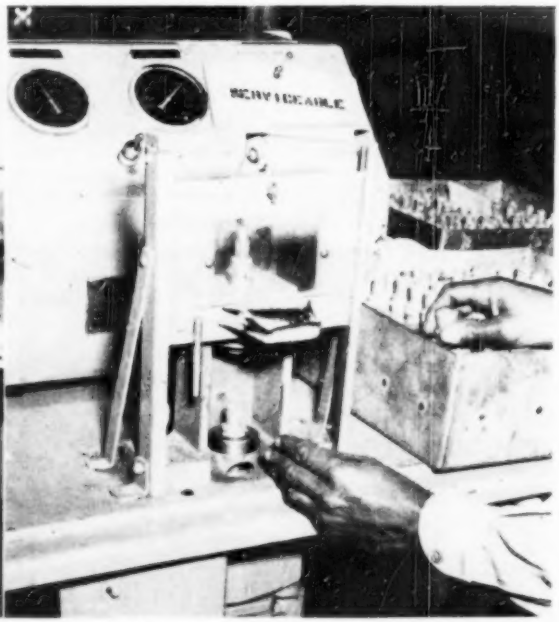
Laundry Renews Spark Plugs

A MECHANIZED laundry is refurbishing 20,000 spark plugs every day at Kelly Air Force Base. Specially built machines clean, adjust, test, and package the plugs at a one-per-second clip. When they've gone through the complete overhaul at the Texas base, the spark plugs are as good as new.

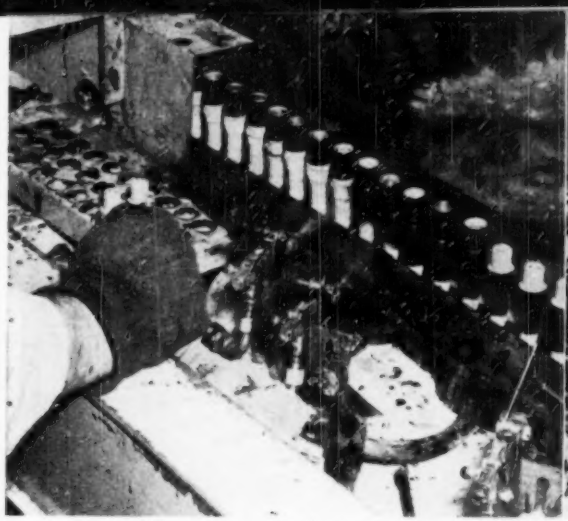
First the plugs are washed in solvent, run through a degreasing process, and blast-cleaned with vapor. After drying, the terminal ends are polished, and the electrodes are adjusted automatically in a hydraulic gauging machine. Then the reconditioned plug is tested under 700 pounds air pressure to see how it will work under actual flying conditions. Spray painting, oiling, packaging, and moistureproofing with wax complete the job.

The new machinery cuts hand labor in half, enabling the Air Force to put old spark plugs back on the firing line for about 19 cents each.

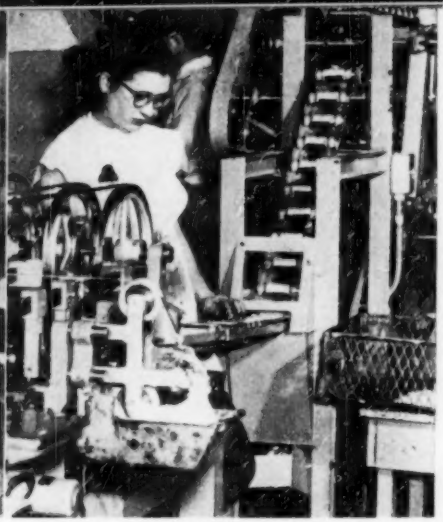
2 **Adjusting the points** is the next step. This hydraulic gauging machine automatically sets them to the correct gap. The machine can handle about 1,000 spark plugs in an hour.



3 **The final test,** for serviceability, is made on the device above. It tries them out under 700 pounds of air pressure, simulating the conditions they would meet in actual use in a plane.



4 **Plugs that pass** the tests are sprayed with black paint. The plugs turn automatically as they go by the spray jets. Protective cylinders cover the ends to keep paint off the threads.



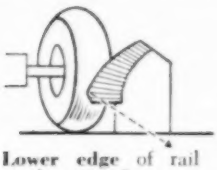
5 **Last step** on the Kelly Air Force Base production line is sealing the packaged spark plugs with waterproof wax. Now they are ready to be shipped back to airfield supply rooms.

New Safety Rail Bounces Cars Back on Road

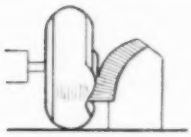
CARS are pushed right back on the road by a new kind of guard rail now being installed on American highways. It is shaped and placed so that it catches the lower part of the tire, turning the wheel back toward the road and slowing it down.

The new safety fence has a concrete rail with a convex curve flaring up from the roadway. As shown in the sketches below, the front tire of a careening car forces itself underneath the lower edge of the rail, countering the tendency to jump the fence. As the wheel rebounds upward, the curve of the rail makes the wheel turn back toward the center of the road. At the same time, friction between the wheel and rail reduces speed, helping the driver regain control.

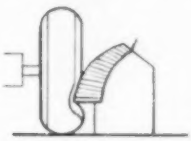
Invented in Denmark, the new fence is now being made here by Hiway Security Guard Corp., Coon Rapids, Iowa.



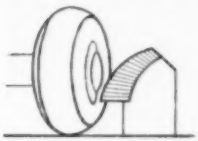
Lower edge of rail catches tire of careening car. Arrow shows direction of force.



"Forward-downward" motion jams tire tightly under rail; curve straightens wheel.



As wheel bounces back and up, rail edge holds it to road, also brakes its speed.



Wheel is turned back toward center of road as it slides along curved safety rail.

The new sign on the old blacksmith shop proclaims the rise of today's Mr. Fixit—the village welder. While Walt Dunbar works on town grader, a tricycle and a tractor wait his torch.

The Village Welder: America's New Mr. Fixit

If a gadget you use is broken, he'll repair it; if a gadget you need doesn't exist, he'll invent it.

By William Gilman

PS PHOTOS BY ELEANOR GILMAN

SPREADING trees shade the village smithy in Cambridge, N.Y. (pop. 2,000), just as the poem says. Only the smith's hammer and anvil are gone. In their place is a hissing, garish flame, symbol of the mid-Twentieth-Century's Mr. Fixit—the small-town welder.

The sign says W. A. DUNBAR, ELECTRIC, ACETYLENE WELDING. Walt Dunbar is more than an expert welder. He's an original cuss whose contrivances save labor for mill operators, farmers, and lumberjacks in the country around. His miscellaneous jobs have even included building seven "living merry-go-rounds," no two alike. They're for exercising race horses.

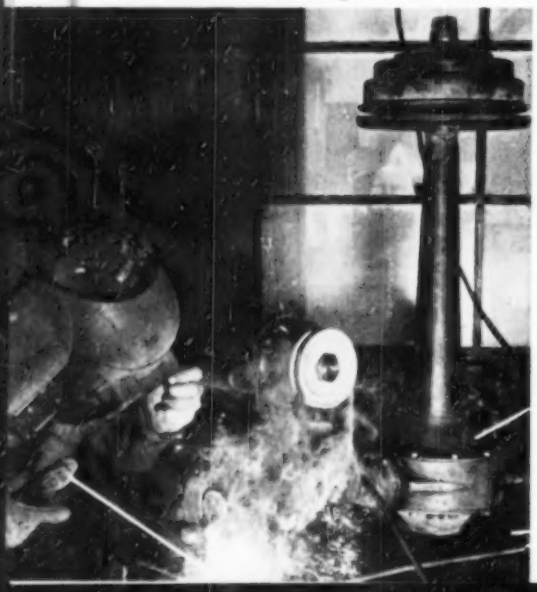
There's nothing surprising about his inventive streak—the Dunbars have long been engineers and mechanics. When Walt was a farm boy of 15, he built and flew a plane homemade from aircraft spruce and an old motorcycle motor. And even before becoming a pro welder, he took out his first patent—on a double-triggered electric pistol that shocks and bleeds Thanksgiving turkeys with humane efficiency.

There's something fascinating about watching sparks fly as this modern counterpart of the village blacksmith heals bent and broken bones of mechanical gadgets—using an oxyacetylene slicer, dab of brazing

Shower of sparks indicates a clean cut as oxyacetylene flame slices through steel floor mat.

The village welder is an inventor, too. This "living merry-go-round," one of seven Dunbar has built, is an exerciser for race horses. It has a ½-hp. motor to keep the horses walking slowly.

Saturday is Dunbar's "inventing day." Below he and apprentice weld gearbox to steel bed for another horse exerciser. Ford rear end at right below connects reduction gear to exerciser.

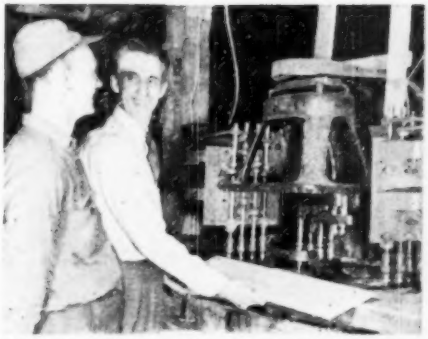


here, and spot of fusion welding there. Usually you'll find a few villagers in his shop swapping tales and tobacco as they approve the way Walt salvages two busted bandsaw blades—taking the best from each, "sweating" them together with one of the new low-melting alloys. Walt flies to New York City every few weeks to pick up the latest dope on methods for handling tricky and expensive steels. The technique sounds easy—more like soldering than true fusion welding. Actually, its delicacy requires an expert.

A scrawled sign outside Walt's shop declares it's closed week ends. Customers who infiltrate find another sign inside warning he'll charge doubletime then. It's all because Walt wants Sundays for fishing or flying, and Saturdays for inventing. But the time of a village welder isn't his own.

Like that day four years ago when Walt had visions of sleeping late and going nowhere near the shop. It was his wedding day. But somebody's fist was hammering the door.

Walt opened up, recognized the photographer from Hoosick Falls and said, "Hey,



Multiple drill is another custom job from Dunbar's welding shop. Made for local manufacturer of wooden pallets, it equals performance of a commercial drill costing ten times as much.

Dunbar's versatile welding truck, carrying both electric and oxyacetylene equipment, plus generator for power tools, is ready to help when car needs repair after mountain road's bumps.

you're not due until the ceremony comes off."

"I know," the photographer said, sadly holding out his camera. "But I can't take wedding pictures with the flashgun reflector busted off the mount."

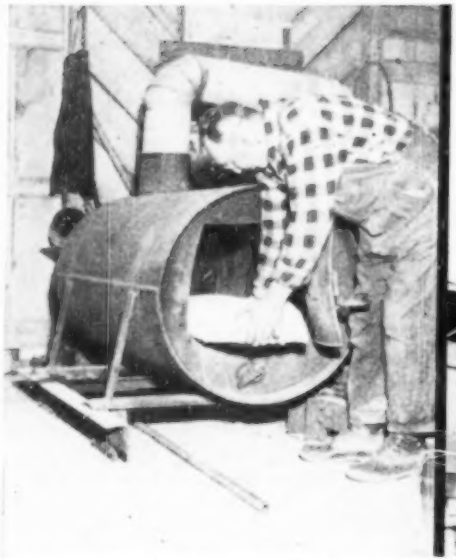
So Walt dressed, went down to his shop, and welded the delicate "white metal." As he was finishing, along came a citizen with a fractured lawn mower. Then in trudged a worried stranger with a tale of woe—a broken spring clip on his trailer truck loaded with 23 tons of lumber. If he didn't reach the furniture factory by noon, the truck wouldn't be unloaded and he'd be stuck there all week end, 200 miles from home. So Walt ground and beveled the jagged ends, switched from gas goggles to arc helmet, chose a proper electrode for that piece of high-carbon steel, ran a few deft beads of fused metal where needed, and sent the trucker away rejoicing.

Yes, Walt got to his own wedding just in time. A few days later, Laura Dunbar joined the parade to her husband's fixit shop. She had a silver candlestick their pup had broken while dragging down the tablecloth.

Teddy's a smarter dog now, has a nest box in the shop, and flops there, face to the wall, when Walt calls "Cover!"—the welder's signal to shield eyes or look elsewhere.

Walt's only narrow squeak while welding came in a boiler. Plumbers were working outside and Walt was arc-welding pipes down inside the 35-foot boiler shell. By mistake, somebody replaced the boiler's bottom cover. Although the top stayed open, Walt's air flow was gone. Down in his hole, Walt was so intent he didn't feel faintness

From Dunbar's "inventing Saturdays" came this automatic-unloading trailer for pulpwood logs. Cables looping load are hitched to a "deadman" tree, lever trips rear gate, and tractor pulls ahead—the whole bundle of logs then slides off neatly, saving unloading each heavy piece by hand. Trailer and automatic devices were built for nearby lumbering firm.



Farmer Harold Sprague wanted a stove that could burn four-foot chunks of wood. Walt Dunbar provided it, and chimney, too. The stove itself was made from a steel drum.

Walt finishes welding the chimney for Farmer Sprague's chunk-wood stove. It is made of galvanized culvert welded together, with well casing connecting it to the stove smoke outlet.

until too late. When his limp hand dropped, the electrode lost its arc, breaking the circuit, and the welding generator on his truck outside began idling. He lay unconscious a long time until somebody wondered why the engine was idling so much and looked in.

A rare accident like that doesn't worry him—he says the real risks, as long as you observe standard rules for personal safety, involve harm to expensive equipment, or botched results with troublesome metals. His touchiest assignment called him out of town to weld up a die for plastic auto-distributor caps. It was unhardened tool steel—easily marred and also apt to get ruinously brittle near a weld. Even pro welders are warned away from tool steel. Walt built a miniature preheating furnace for the job, phoned long-distance to check on the metal's expansion rate, and armed himself with special arc electrodes.

After such precautions, the welding itself took only 45 minutes—first a couple of tack welds serving as temporary grips to hold the joint parts in place, then increased amperage for the permanent bond.

A different welding challenge summoned Walt up a snowy Vermont mountain road to a crawler tractor stranded with sprocket spokes broken. Using his gas torch as a "grinder," Walt smoothed and beveled the fractured ends, then switched to arc for welding. He was surprised at being able to touch each hot bead as soon as it was run. Later, he learned he'd been welding at 35° below zero!

That job was for Jim Phillips, head forester of a local lumbering outfit that has used Walt's welding arm to make its operations among the most modern in the country. Dunbar figured out a winch that carries spruce logs down from previously inaccessible peaks, a portable cabin with built-in stove to keep lumberjacks contented, and a trailer that unloads logs automatically.

Similarly, Walt has helped a small Cambridge mill that makes lift-truck pallets—those portable platforms that speed transportation and increase warehouse capacity.

Welding is literally playing with fire. But Walt points out that there's little danger if common-sense safety rules are followed. His coveralls may be soiled, he says, but never with gas, oil, or grease. And anybody foolish enough to strike his arc on a gas tank has no business welding—he should take up something less risky, like being shot out of a cannon. END

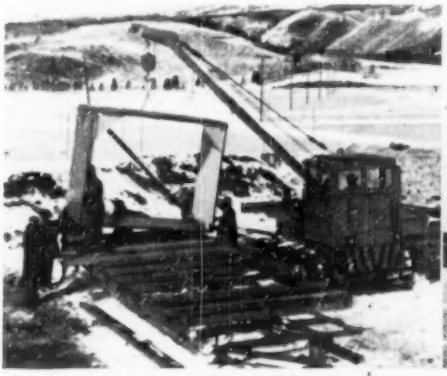
Join the Navy and live in a trailer—one that rides over Arctic snows on bobsled runners.

Six-man crew needs only about 2½ hours to put up a "wanigan" trailer and get it ready to live in. Knocked down, the shelter makes up into 18 packages that are easily transported by air.

Navy's Arctic Houses Ride Sleds

IGLOOS may be all right for Eskimos, but the Navy has shelters more like home for Arctic-posted men. They are sled-borne trailers with insulated walls—and oil heat.

Called "wanigans" (after the name for portable huts used by lumbermen), they are quickly set up from 18-package units that can be transported by air. The sections forming the wanigans are four inches thick, made of wood framing faced on both sides with plywood. There is sleeping room for five men in each shelter, which is 8 by 10 by 24 feet in size. Separate wanigans are used as galleys.



Crane speeds assembly job although all parts are light enough to be positioned by hand. Wall sections four inches thick have mitered edges stripped with rubber to assure windtight joints.

Bigger wanigan, providing floor space 25 by 50 feet, is intended for permanent installation at Arctic camps. In test at Port Hueneme, Calif., 16 men put one up in just 43 minutes.

Volkswagen has three models besides this sedan. Hood covers spare tire, gas tank, luggage.

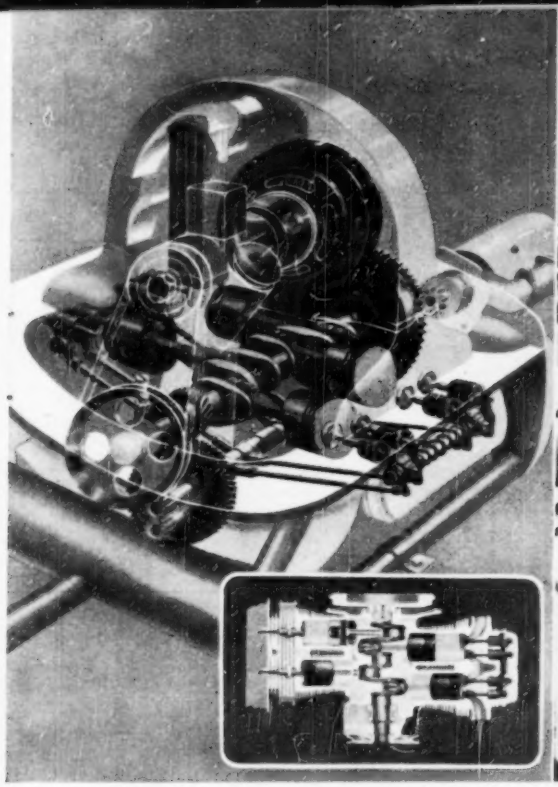
Hitler's Flivver Now Sold in the U. S.

THE Volkswagen (People's Car) that Hitler promised but never delivered to Germany's civilian market has shown up in America. It's under a democratic aegis now, a product of the West German Republic. But it's a dead ringer for the prewar prototype (see "This Was Germany's Flivver," PS, May '44, p. 136).

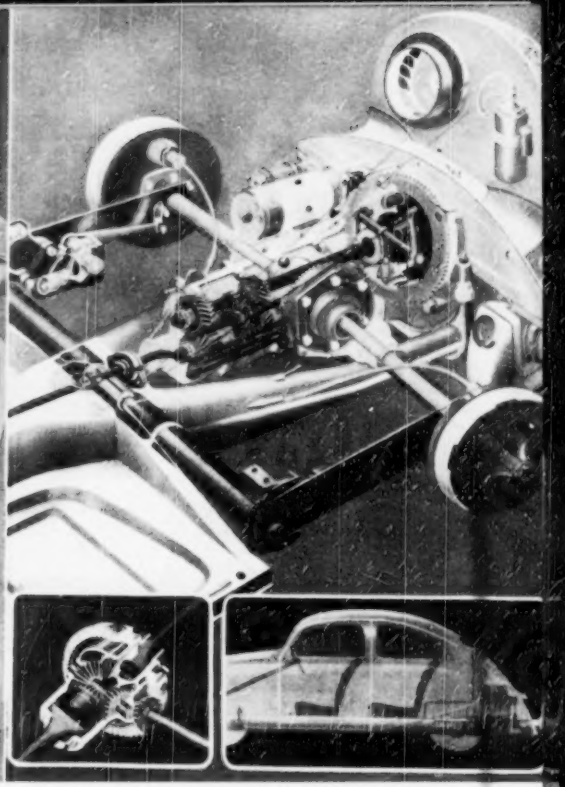
A homely auto to most U. S. eyes, it also has some homely virtues. It gets good mileage out of its fuel, and it burns the cheapest gasoline without pinging. It's rugged. Its body is squeakproof. It's well sprung. It has better ground clearance (8.35 in.) than most U. S. cars. Its articulated rear axle accommodates the back wheels to bumps with little loss of traction. Added credits: a tubular-spine chassis; low unsprung weight; and a low-speed, low-wear engine.

The engine probably is the best part of this car. Air-cooled, it is the same engine that served General Rommel's Afrika Korps without a whimper in the desert heat. It peaks at 25 hp. at the unusually low speed of 3,300 r.p.m.

Beyond that, whether or not you like the Volkswagen will depend on your personal tastes in automobiles. It's tiny, yet it gets less gas mileage than the higher-compression Renault (PS, Aug. '50, p. 90). A big man has to jackknife to get into the back seat. By American standards it is underpowered, even for its size. The pint-sized flat engine must be revved up considerably in third gear before it can take the load in high. Of the four forward speeds—the U. S. agent calls the fourth gear "overdrive"—only the top two are silent and synchronized.



Valve-in-head engine is opposed type with three main bearings. This phantom view shows shrouded fan (top center) that blows air on finned cylinders. Bore is 2.95 in., stroke 2.52 in.



Power train from clutch runs via a shaft crossing above differential (inset left) to gearbox, and thence back to differential. Second inset shows how far back engine is located.

The first two must be double-clutched to prevent clashing.

The good springing doesn't keep the short (94½-in.) wheelbase from quick-pitching on bumps in the road. And the price is not much different from those of more commodious imported cars such as the Hillman Minx.

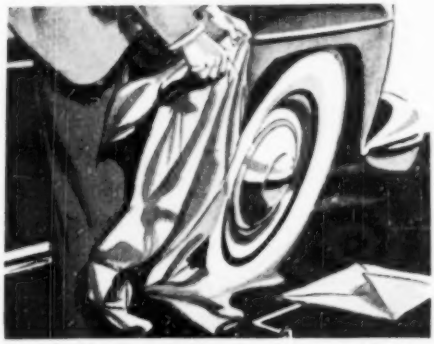
The engine, like the Renault's, is mounted in the rear for better roadability. The designers explain the plunging hood-line as an aerodynamic form that presses the car down on the road harder as it goes faster, perhaps at the cost of added road friction.

Demonstrated in New York and at the International Trade Fair in Chicago last August, the Volkswagen had a high novelty value. Leaf-type torsion springs, jacking pads, an oil cooler, and warning lights to signal low oil pressure, electrical trouble, or a broken fan belt all boost its gadget appeal. But whether it has enough utility here to coax dollars from American pockets remains to be seen. END

Volkswagen's interior is severely plain. It gives about 34 miles per gallon, has low compression (5.8-to-1), makes about 60 m.p.h., and sells in this country for $1,280 and up.

I'd like to see them make . . .

Everyone has his own pet idea of some gadget he would like to see in general use. What is YOURS? *Popular Science* will pay $5.00 for each one published. Use government postcards only. Contributions cannot be acknowledged or returned.

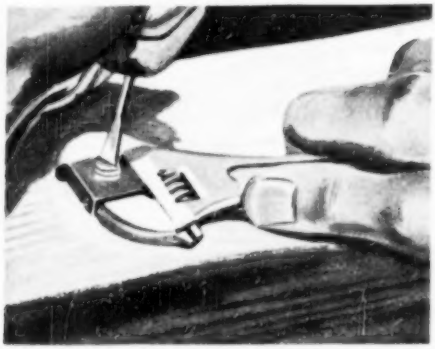


Disposable coveralls to carry in the car for tire changes or roadside repairs. A pliable paper garment that could be used one or more times before discarding would save cleaning bills.—*D. R. Phelps, Childersburg, Ala.*

An automobile horn that would sound only a low-volume toot whenever a soft warning is required but would increase in volume the harder you pressed down on the horn button.—*K. M. Isbell, Los Angeles.*

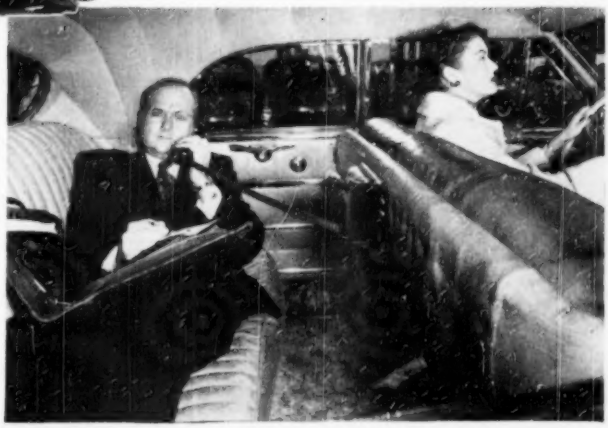
Electric mixers with built-in timers. Such mixers could be set for any desired beating time and would save standing about and timing the recommended beating interval.—*M. E. Fairbanks, Lacomb, Ore.*

Cans for motor oil provided with a combination opener and pour-spout. This would permit motorists who carry their own oil on trips to open and pour it without spilling.—*Marion L. Rhodes, Knightstown, Ind.*



Bolts with a slot in the threaded end. This would help you hold a bolt from turning while you snugged up or loosened the nut. And it'd also help where it's hard to get a wrench on the bolt.—*Wm. G. Kessel, Terre Haute.*

Custom Car Built As Luxury Office

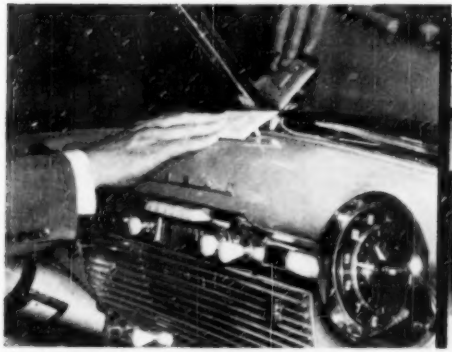


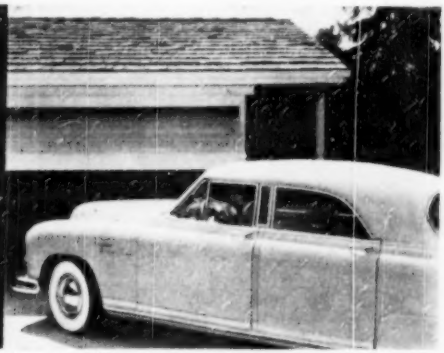
Cushioned on robin's-egg-blue leather, Joe Schulte once talked to friend in Italy while car rolled along Los Angeles street. He's using extension; other phone is up front with secretary.

Front seat has unusual fold-down arm rest (below). Mr. Schulte uses it when making notes, but it also comes in handy as a seat for his six-year-old daughter. Rest is all padding, soft both sides.

LIKE many men in the construction business, Joe Schulte uses his car for an office. But not many mobile offices are as plush as this one—with robin's-egg-blue leather cushions, fur rugs, two telephones (incoming calls flash a light, ring a bell, blow the horn, or turn on the spotlight), and an automatic garage-door opener.

Mr. Schulte, who is director of research for Kaiser homes in Los Angeles, ordered his 1950 Kaiser Custom Virginian that way from the factory. A hard-top convertible, it has special insulation under the nylon roof cover to keep the inside cool. END





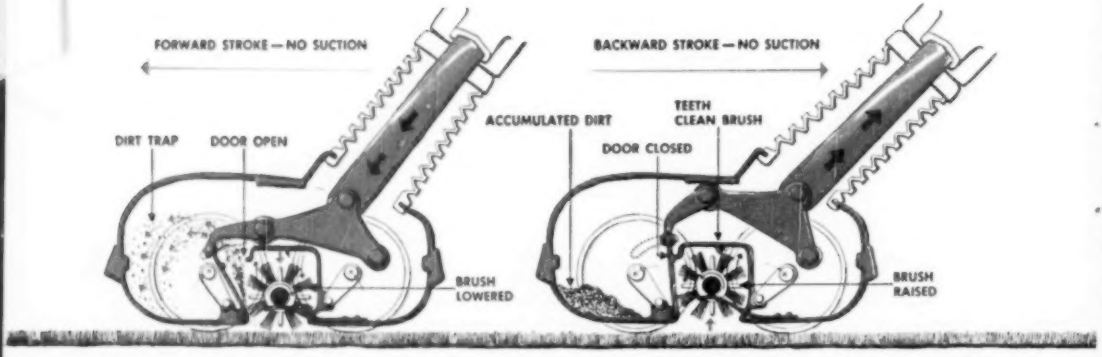
No bother about opening garage doors with this luxury automobile. Two blocks from home, Mr. Schulte touches the button on the dashboard (above, left), and a radio signal makes the door go up (above, right). Once inside, another touch on button and door closes itself.

As carpet sweeper, new double-duty cleaner (left above) does quick, easy cleaning jobs like picking up ashes and crumbs. Sweeper head has rotating brush like conventional carpet sweepers. When attached to vacuum unit (right above), cleaner adds suction to brush action to remove embedded dirt, is said to be 20 percent more efficient than slit-type, brushless cleaner heads.

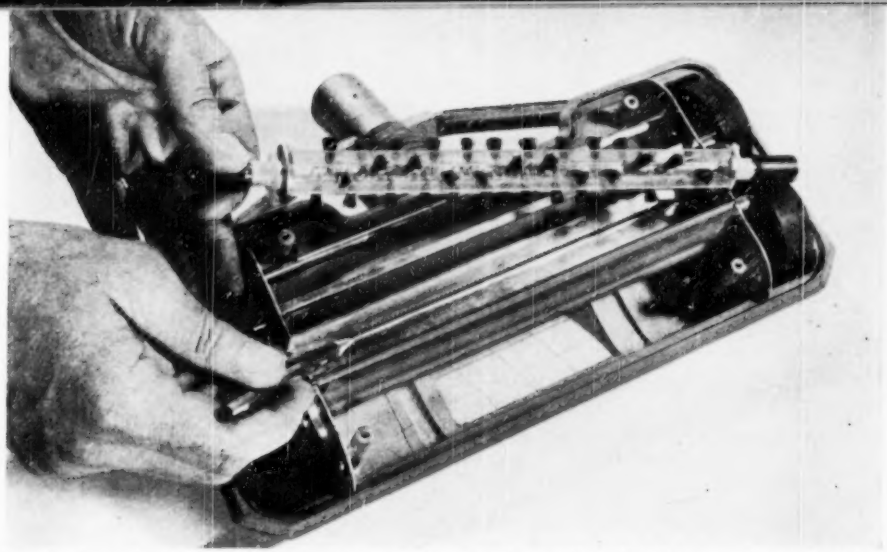
Vacuum Cleaner Doubles As Carpet Sweeper

By George H. Waltz, Jr.

PS PHOTOS BY HUBERT LUCKETT



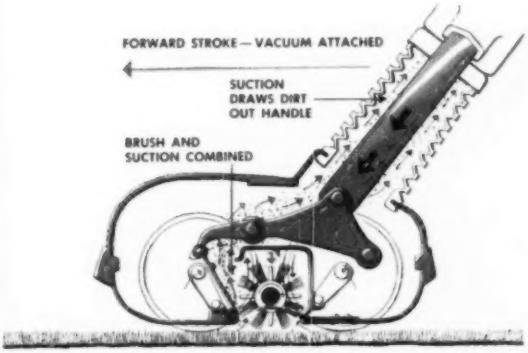
On forward stroke (left), downward pressure on handle pushes open door to catch dirt whisked up by brush. Same pressure forces wheels together, pushing brush down against carpet. On backward stroke (center), upward pull on handle closes door, trapping dirt. Wheels spread



Brush cleans itself by rotating against row of fine teeth along suction slot. Teeth strip off lint, threads, or other dirt that may cling to bristles. Brush is rotated by cleaner's wheels.

PERHAPS you've found that house-cleaning chores call for both a modern vacuum cleaner as well as the old-fashioned carpet sweeper, and yet you've been reluctant to invest in both. Now, with this new combination cleaner, you can have both in one. If you're in a hurry and the dirt is light, just run it over the floor like an ordinary sweeper. For more thorough cleaning jobs, hook it up to the separate suction unit and you have a vacuum cleaner.

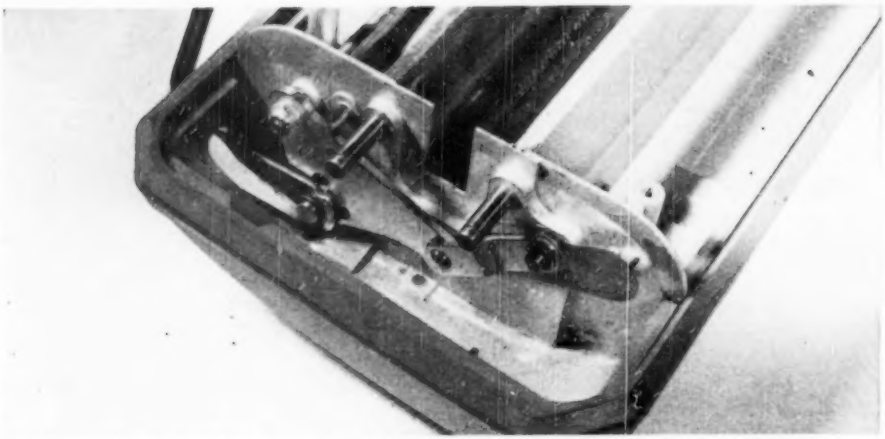
The unique combination, recently put on the market by the Lewyt Corp., of Brooklyn, N. Y., was engineered to combine the best features of the upright cleaners and the tank-type cleaners. Like the uprights, it has a revolving brush to pick up surface litter, and like the tank types it has high suction to lift out the dirt and grime embedded deep in the pile of a rug. And when not attached to the vacuum, it can be used as a conventional hand-operated carpet sweeper. Dirt-removal tests made under controlled laboratory conditions have shown that as a carpet sweeper it is as efficient as a regular sweeper, while as a nozzle for a vacuum cleaner it removes 20 percent more dirt than the brushless, slit-type nozzle used on ordinary tank-type cleaners. Although designed for use with the new Lewyt vacuum cleaner, the sweeper can be used with older models made by the same manufacturer.



apart, and spring pushes brush up off floor. With vacuum unit attached (above), suction draws dirt out, also cleaning brush and sweeper trap.

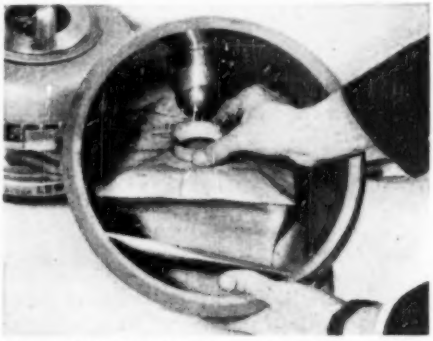
Sweeper Cleaned Automatically

The secret of the double-duty cleaner lies in an ingenious combination of a self-cleaning brush revolved by four wheels that roll on the rug, a dirt trap and valve, and high suction. As the new sweeper head is pushed forward along a rug, a valve in front of the revolving brush opens to receive the dirt whisked up by the brush. On the backward stroke, the brush is raised, and the valve closes to trap the dirt. When the sweeper is attached to the vacuum unit, suction is added to the cycle, providing brush and suction on the forward stroke and suction, which also rids the brush of any lint and dirt that may be snared in its bristles, on the rearward stroke. Thus embedded dirt is removed on both strokes, surface litter on the forward stroke. As a carpet sweeper, the cleaner never has to be manually emptied or



Simple mechanical linkage opens and shuts door in sweeper head to trap dirt in dust chamber. When sweeper is pushed forward, downward pressure on handle forces linked arm to slide forward, opening door. When sweeper is moved back, handle pulls arm, shutting door.

Vacuum unit consists of motor on top and receptacle at bottom to catch dirt. Dirt falls into disposable paper bag that is discarded when full. Triple filters clean air expelled into room.



Disposable dust bag is easily put into place. Collar of the bag is simply slipped over the neck of the suction pipe. When the bag is full, it is easily removed and discarded.

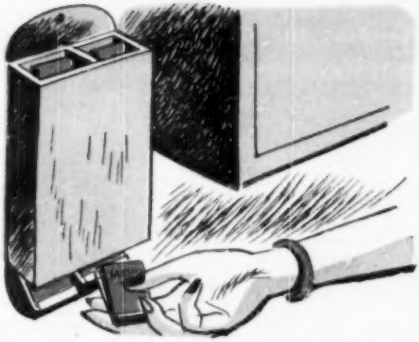
cleaned—the accumulated dirt is automatically sucked out every time it is attached to the vacuum unit. For convenience, the hollow handle attached to the sweeper head also serves as a suction tube when it is used with the vacuum.

Besides the double-duty sweeper head, the new Lewyt vacuum cleaner also boasts an additional innovation—the use of disposable paper dust bags that also act as primary filters (there are two more sets of filters to insure dust-free exhaust air). The new disposable dust bag comes with a rigid cardboard collar that slips on the tubular intake pipe within the bowl. The collar is so designed that as the bag fills up with dirt and expands, the slip-on connection becomes tighter, thus preventing any possible leakage. When the dust bag is full, it can be removed by taking off the motor head, tilting the bowl on its side with the bag collar up, and pulling down on the collar. The filled bag then can be thrown away, and a new disposable bag put into place.

The new Lewyt, with its carpet-sweeper nozzle, its disposable dust bags, and its multiple dust filters, is the latest brainchild of 42-year-old Alex Lewyt, millionaire inventor who at the ripe old age of 13 was already making himself spare change by dreaming up useful gadgets and peddling them to tradespeople in his New York City neighborhood. Prophetically, his name "Lewyt" rhymes with "do it." END

Keeping the Home Shipshape

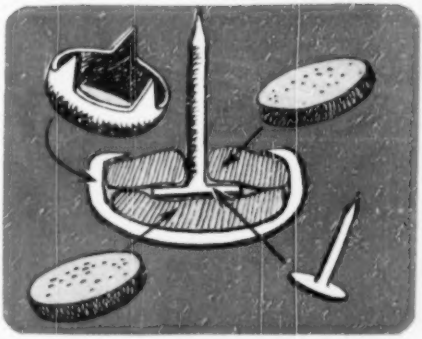
You can add extra shelf space in the bathroom by building a tray over the radiator. Use plywood for the tray and metal for the bands that clamp it to the radiator.



Five pieces of plywood and a piece of sheet aluminum form a book-match holder for shop or kitchen. Curve the aluminum lip at the bottom to keep the books from falling out.

To cut up canned sliced pineapple, slip a knife down the center hole of the slices. Cut from the center out to the can and you'll quickly dice all the slices at the same time.

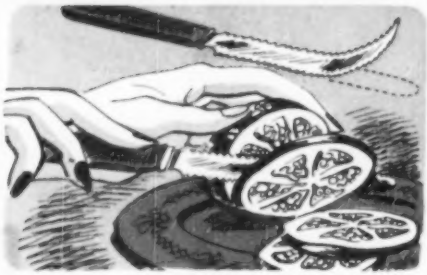
To make a dustless dustcloth, wring out ½ yd. of cheesecloth in water. Soak it in a mixture of 1 oz. oil of citronella and 1½ oz. denatured alcohol, and let the cloth dry.



Here's a cushioned furniture glide. Cut disks from an inner tube. In an ordinary glide, sandwich the head of a large tack between the disks. Bend down the points of the glide.

Please turn the page for five more suggestions.

Keeping the Home Shipshape

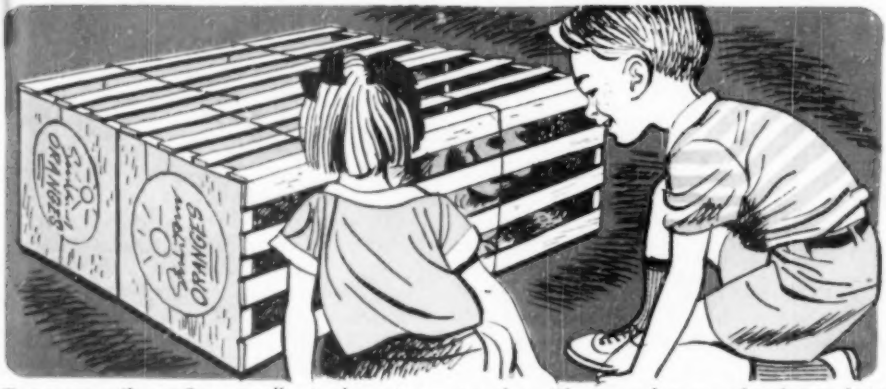


A saw-toothed grapefruit knife may be straightened out and used to cut many vegetables more efficiently than an ordinary knife. Curved tip is easily flattened by bending.

Add extra kitchen storage space by building shallow shelves on the wall behind a door. Such shelves will hold canned goods, spices, pie and cake tins, and pot covers.

To prevent a little paint from skinning over, drop clean stones in the can to raise the paint level to the top before putting on the lid. This excludes air and retards skinning.

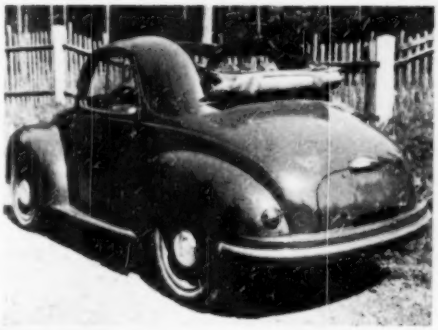
Punch a few holes in the lid of a powder box to make removal of the lid easy. The holes let air into the box as you raise the lid, letting the lid slide off smoothly.

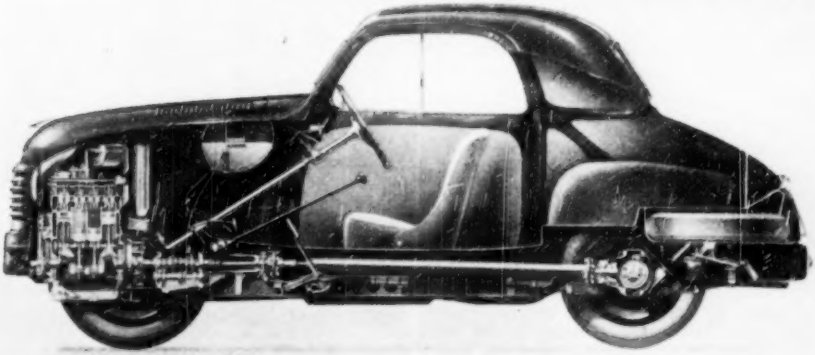


To temporarily confine a small animal—a cat or puppy—face the open tops of two orange crates together. The space between slats lets in light and air. Apple crates make a sturdier cage.

New Fiat Is Big Car in Miniature

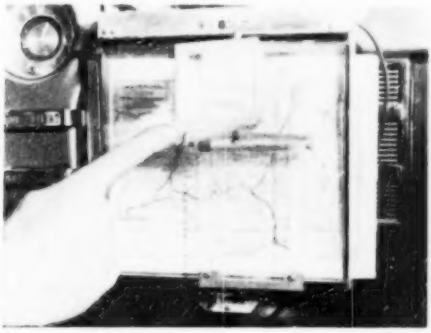
ECONOMY in driving and comfort in riding have been combined in this new Fiat 500C to provide low-cost transportation for European motorists. Designed for two passengers and luggage, the compact, four-cylinder car has a top speed of 65 m.p.h., and averages 47 miles to the gallon. The canvas top lowers between side members, giving steel overhead protection. As shown in cutaway below, the engine is forward of the front axle, and the transverse front spring passes over the clutch and flywheel.





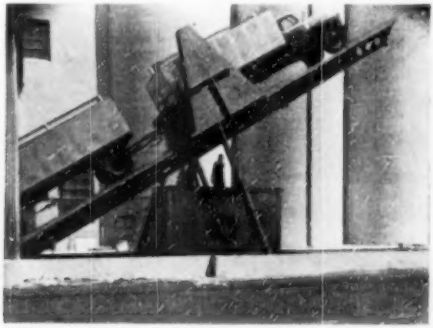
Holder Magnifies Road Maps

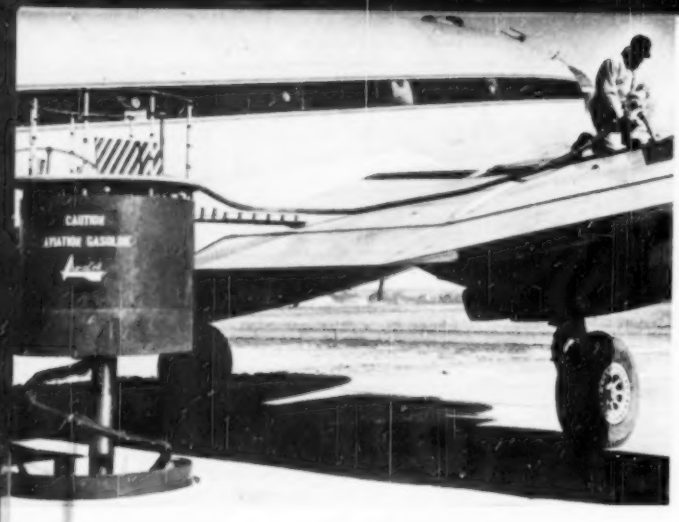
YOU can easily read small type on road maps by day or night with the illuminated holder shown fixed to an auto dashboard below. A small square of Plexiglas slides over any part of the map, one side magnifying two times and the other four times. Two shielded bulbs light the map at night. The holder can be adjusted for use by either the driver or front-seat passenger.



Tilter Dumps Giant Trucks

THE heaviest truck-and-trailer units in operation can be dumped at the push of a button on the 50-foot tilting platform shown below. Hydraulic rams with 7,000 pounds pressure upend the trucks to 35° off horizontal in 50 seconds, ready for gravity dumping. The Speed-Giant tilter, built by Pacific Coast Engineering Co., Alameda, Calif., can handle 55-ton loads.





Lift Fuels Planes

THE man refueling the plane at left rode to wing level on a platform atop the cylindrical steel drum. By flipping a switch, he raised it from its underground pit, then projected a "gangplank" to the wing. The hydraulic lift, five feet in diameter and three feet high, contains fuel hose, meter, fueling controls, static-grounding wire, and a CO_2 extinguisher. Todd Shipyards claims it speeds fueling at busy airports.

Umbrella Is One-Man Top

ALTHOUGH one man can carry and erect the 20-foot umbrella at the right, it can shade from sun or shelter from rain more than two dozen people. It is recommended for creating shade in new treeless housing developments. It also will cover up the players of a whole bridge club, shade the children's outdoor play area, or protect picnics from sunburn or sudden showers. The Strawn Engineering Laboratories, Vista, Calif., claim it is the world's largest.

Cherry Pits Punched Out

THE hands below show the workings of a U. S. Rubber Co. machine that pits 1,000 pounds of cherries an hour. Cherries, falling into rubber cups on a rotating cylinder, are punched by a bank of needles. The pits are forced out through holes in the bottom. Rubber cushions protect the fruit.

Plastic Cushions Insulators

A MOLDED Tenite plastic bushing (below), developed by Western Electric, reduces breakage of glass telephone-line insulators mounted on steel pins. The tough, resilient plastic provides a cushion between glass and steel. The bushing has threads corresponding to those on glass insulator.

Speeding at 50 m.p.h. and slowly revolving to the right, car smacks into the ground hard.

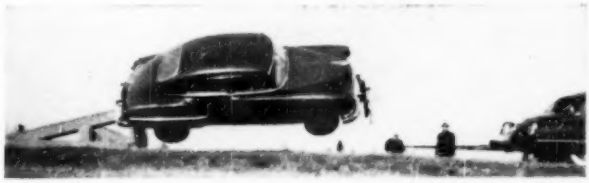
Roll-Over Test Checks New Cars

WHAT happens to an automobile in a roll-over at high speed? That's a question manufacturers want answered before they put a new model on the market. And one way to find out is to roll one over.

In the picture sequence on this page you see a brand-new Oldsmobile sedan, going 50 m.p.h., being overturned at the General Motors Proving Ground in Milford, Mich. The test determines the durability of bodies and their resistance to impact.

Nobody drives the car. It is towed fast toward a ramp. With split-second timing, the tow car cuts itself loose at the ramp and skirts around it. The left wheels of the test car hit the ramp. For what happens after that, see the pictures. END

Test car at right is in mid-air after hitting ramp. Revolving, it crunches into ground with the hood and top taking most of impact. Results (below) are satisfactory—doors open easily, no glass is broken. Car was started and driven away under its own power.



Aids to Modern Living

Lever Wrings Out Mop. Hands stay dry when a housewife scrubs the floor using this mop with a replaceable foam-rubber head. When the wringing lever is pushed forward, as above, a series of rollers squeeze out the water. Made by Artmore Co., Milwaukee, the mop also can be used to apply liquid wax. It is priced at about $6.

Closet Gets Plug-In Light. Any closet can have an automatic light, if the unit above is installed in the door frame. Plugged into an electrical outlet, the device has a push-button switch that turns the light off when the door is closed, and on when the door is opened. Slater Appliances, Woodside, N. Y., prices it at about $2.

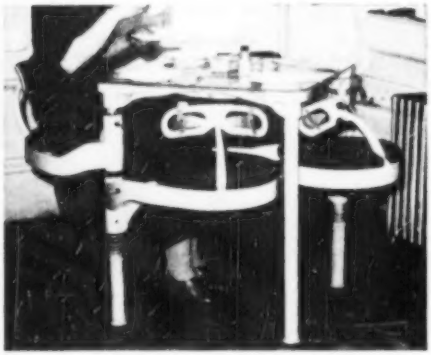
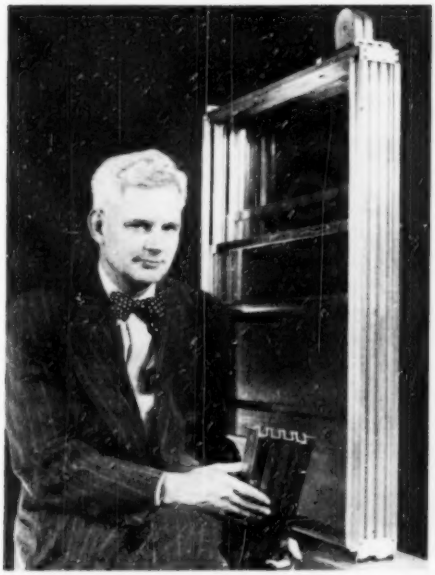
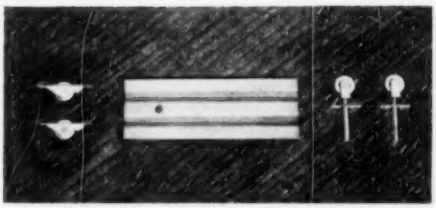


Table Has Built-In Chairs. Four legs do the work of 20 on this table with built-in, legless chairs, invented by Ronald Curry, of London, England. Attached to the table legs, the chairs pivot outward as seats. The backs of the chairs fold downward so they can be swung under the table when mealtime is past.

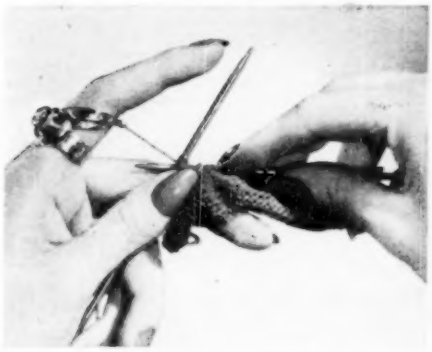
Hanger Fits Any Garment. This hanger has plastic shoulder pieces pivoting on the frame so that it can adjust itself to the size and cut of any garment. Made by Hang Rite Co., of Los Angeles, Calif., the hanger is wider at the ends than at the neck, conforming to the shape of clothing. A spring-type rack holds trousers or skirts.



Storm Sash, Screen, in One. Two double-hung windows and a screen are mounted in channels in the aluminum frame above. The house sash and storm sash are held tightly in place by sponge-rubber pressure. Any unit is easily removed for cleaning by pressing one side against the rubber. Fleet of America, Buffalo, makes the units.



Sliding Doors Ride Smoothly. Spring tension built into upper rollers, shown at top right of model sliding doors above, adjust for any unevenness that might cause the doors to stick. In panel just above are spring rollers, right, a sample of track, and ordinary bottom rollers, left. Made by Standard-Keil Hardware, of New York City.



Ring Makes Even Stitches. Knitters and crocheters are said to make more even stitches and to increase their speed when wearing the ring above. Worn on the index finger, the ring has an adjustable tension spring that feeds thread uniformly. Called Evenit, the ring is priced at $1 by Crane Products Corp., of New York City.

Spreads As It Shreds. Rock-hard butter right out of the refrigerator can be readily sliced and spread with this new knife, says the inventor, E. Webb, of London, England. It is an ordinary knife, with small holes stamped in the blade. The holes, explains Mr. Webb, deliver spaghetti-like shreds that can be knifed on evenly.

Building Blocks Made on Site

ORDINARY dirt is the chief ingredient of the building blocks shown at right above. They came from the new mobile machine above that feeds nine parts of dirt, right from the site, to one part of cement—plus a spray of water if needed—into a mixer. Dumped into a blockmaker, the mix gets an hydraulic squeeze, and out come the blocks at a rate of 8 to 10 a minute. The unit, a development of older rammed-earth machines, is mounted on wheels for hauling from job to job. The maker, Economy Building Block Machine Co., Topeka, Kan., claims that blocks made from Topeka dirt withstood a load of 2,430 pounds per square inch when lying flat.

Containers Speed Rail Cargo

TIME and labor are saved both coming and going by a system of "house-to-house" handling of small cargo loads developed by the German State Railways. Containers of five-ton capacity, shown above, are delivered to a shipper by a specially designed truck. When they have been filled, the truck hauls them to the rail yards and automatically loads them on a freight car. At destination, process is repeated in reverse.

Tractor Is Also Midget Car

WHEN this farmer has plowed his field, he can raise the plow with an hydraulic lift and scoot to town at 60 m.p.h., taking a passenger along. FarmOroad was developed by Crosley Motors to give the small farmer a combination light tractor and utility vehicle. The 26½-hp. engine has six forward and two reverse speeds. A rear power take-off can operate power-driven equipment. The basic unit is priced at about $800.

MECHANICS
and
HANDICRAFT
REG. U. S. PAT. OFF.

Now's the time and here's how to

Button Up Your House

By Bernard Gladstone

PS PHOTOS BY W. W. MORRIS

EVERYBODY takes down screens and puts up storm windows when the days begin to get chilly. But that's only one step in readying your home for another winter.

A little time spent in checking walls, windows, roof, and foundation will pay off well because

a tightly sealed house will reduce both your fuel bills this winter and your repair bills next spring. Even a small crack in a wall or around a window frame can let in damaging water seepage.

You'll need only simple tools and inexpensive materials to button up your home snugly against wind and snow. The important thing is not to overlook any potential danger spot. Here are the places to check:

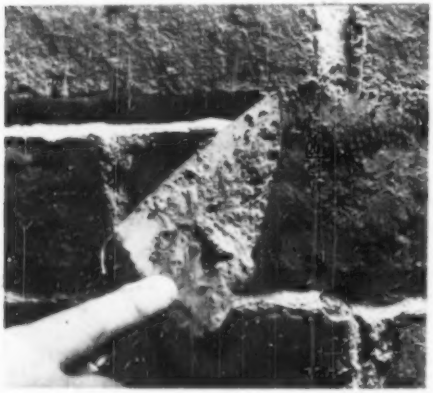
Foundation. Examine the outside of your foundation walls where they are above ground. Patch all cracks. Otherwise, drifts of snow may melt against the foundation and water will seep into your cellar, causing dampness and mold.

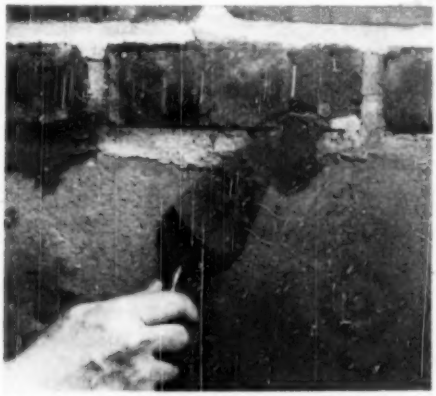
Repair small cracks with calking compound. Larger breaks should be patched with a waterproof cement. You can make a good mortar for patching by mixing one part Portland cement, one part hydrated lime, and five parts sand.

If you have only a few patches to make, it'll pay you to go to the hardware store and buy a ready-mixed patching cement. These are sold in small quantities (5- or 10-lb. bags) and all you have to do is add water. But whether you mix your own mortar or buy the ready-mixed kind, don't start patching until you have thoroughly wet the area to be patched.

Let the patches dry completely. Then go over the foundation with a liquid waterproofing compound. This can be either sprayed or brushed on. Let this dry for a day or two and then brush on an oil-base paint that's made for stucco and cement. This will seal the surface of the concrete. Now go inside the cellar and repeat the patching, waterproofing, and painting.

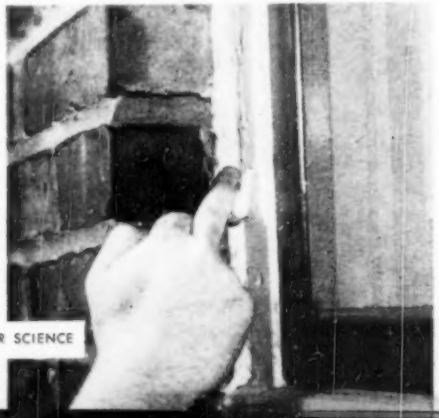
Be sure to do this work after a long stretch of dry weather when the concrete is thoroughly dry. Dampness in the concrete will eventually work its way out, causing





Scrape out loose or crumbling mortar between bricks and point up the joint with waterproof cement. Check carefully along top of foundation where it meets the wall. Repair minor cracks with calking compound, but fill larger ones with waterproof cement (above).

If you have only a little calking to do and you don't have a calking gun, use a calking tube like the one shown below. You squeeze the compound out like toothpaste by turning the key at the bottom of the tube. Then smooth out the compound with your finger, as below.



painted concrete surfaces to blister and peel.

Walls. Look over the exterior walls of your home. If you have a frame house and it needs paint, by all means try to do the job before winter. Paint helps seal the surface against moisture. If you can't paint the entire house at this time, touch up all bare and peeling areas. Patch up split siding with putty and paint. Nail down loose boards.

Examine stucco and concrete walls for cracks. As with the foundation, scrape the cracks clean, wet them down, and fill with waterproof cement. Check brick walls for loose, crumbling mortar. Scrape the joint out about ½" deep and point it up with waterproof cement.

Doors and windows. Inspect the calking around all doors and windows, re-calking where necessary. For best results, use a top-quality calking compound and a calking gun. If you don't have a gun and don't have much calking to do, use a calking tube. This has a nozzle like a gun, and a key on the other end. You wind up the key to squeeze out the compound. It's also a good idea to check the putty on all windows. Scrape out loose or cracked putty, give the wood a coat of linseed oil, and let it dry. Then put in new putty.

Now go inside the house and see if there are any drafts around windows or doors. Move a lighted match around the edges of a window. Even a slight draft will show up by blowing the flame. A draft means a heat leak, increasing your heating cost.

To stop drafts around doors and windows, you'll need weather stripping. Flexible metal weather stripping is easy to install. It has a fabric or rubberized edge on it. Tack it to the door or window frame with the soft edge snugly against the door or sash. After hanging your storm sash, check them to make sure they fit tightly. If they leak air around the edges, weather-strip them also.

Gutters and downspouts. If downspouts and gutters are not kept clean, water may accumulate and freeze. Ice in gutters often backs up under the roof shingles, causing damage. If a downspout is clogged near the bottom, the accumulated water will freeze and often burst the spout.

Sweep leaves and other debris out of the gutters with a whisk broom. If a downspout is clogged, open it up with a stiff piece of wire. A downspout should have a wire-mesh guard over the top end to keep out leaves.

After cleaning out the gutters, paint the

Scrape out loose or cracked putty and put in new. Putty knife with special-shaped blade turns out neat, professional-looking job.

Use lighted match to check around inside of doors and windows for drafts. Heat losses will occur if doors and windows fit loosely.

Weather stripping is answer to loose-fitting doors and windows. Here flexible metal strip is being nailed to outside of door frame.

Clean out gutters and downspouts. If gutters are copper, give them an inside coat of spar varnish. If gutters are wood or tin, paint the insides with black roof coating. Check straps, fastenings, and joints to make sure they're strong enough to support heavy snow loads.

insides for protection against weather. Use spar varnish on copper gutters and black roof coating on wooden or tin ones.

Roof. Your roof takes more punishment than any other part of your home's exterior. It should be inspected annually to head off expensive repairs. If your roof is covered with wooden shingles, check for curled, split, or loose shingles. Nail down loose ones and replace defective ones. If your roof is of composition shingles, stick down any loose ones with a dab of roof cement.

Climb up on a ladder and examine the shingles at the eaves and along the peaks of the roof. Those are dangerous spots for loose shingles. Icicles form along the edges of a roof. The sun will often partially melt them, and then the heated interior of the house will draw the moisture in under the shingles. Use roof cement to seal openings and to cement down loose shingles.

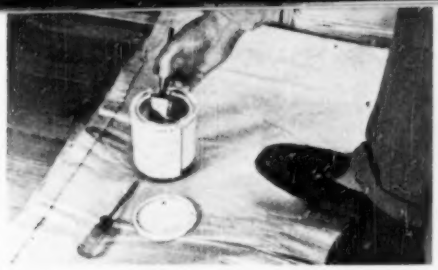
Check flashing around chimneys and in the valleys of the roof. Seal any openings or loose joints with roof cement. Melting snow will ferret out even the smallest crack and cause a leak that's difficult to trace.

Snow guards—if your roof is fitted with them—require no special maintenance. These metal guards prevent a heavy load of snow from sliding off the roof. They're useful over a doorway or along a roof that overhangs a flower bed, for instance. A heavy pile of snow, sliding off the roof, can damage a flower bed.

Heating systems. Interior passages of coal furnaces should be cleaned, and certain parts of oil burners and forced-air blowers should be oiled as well as cleaned. And if you have circulating-air heat, don't forget to clean or replace the filters in the blower chamber. END

Carefully inspect flashing around chimneys. Seal all loose joints or other openings with liberal applications of roofing cement.

Would you like to use your basement more this winter? Would a tile floor increase its usefulness? Next month, POPULAR SCIENCE *will tell you how to lay the tile yourself.*



Paper Dropcloth Is Disposable

THIS chemically treated paper dropcloth resists paint penetration and also repels water. Since its cost is low—this 10′ by 12′ size is priced at about $1.50—it can be thrown away after a paint job. Another size, also made by the Hebert Paper Specialties, Inc., Buffalo, N. Y., is 5′ by 9′.

Lighter-Fluid Cans Re-Used

EMPTY lighter-fluid cans serve as excellent dispensers for other liquids to be applied in small quantities. To fill an empty container, use a one-hole rubber stopper, as shown. Squeeze and release sides of the can. This pumps air out of the can, allowing liquid to replace the air. When bubbles stop rising, the dispenser is filled.—*A. Brennan, Phila.*

Shaver Lights Its Own Way

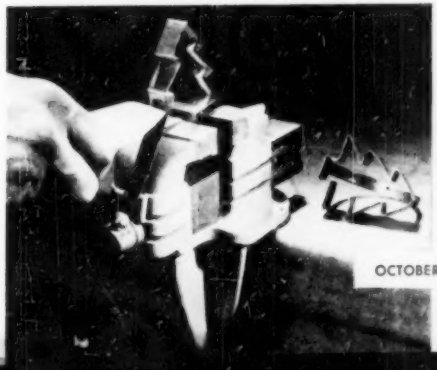
POOR room lighting—or none at all—won't keep Fritz Wankmueller, of San Diego, from getting a good electric shave. He turned two dime-store items into an attached light for his shaver. One is a base outlet shaped to the contour of the shaver with a strip of emery cloth. The other is a plug-in night light. He wired the shaver to the socket and plugged in the light. One electric cord connects both units. A couple of stout rubber bands hold everything together to the line.

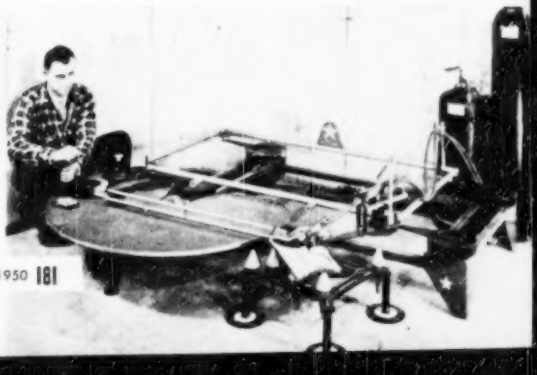
Cookie Cutter Shaped on Form

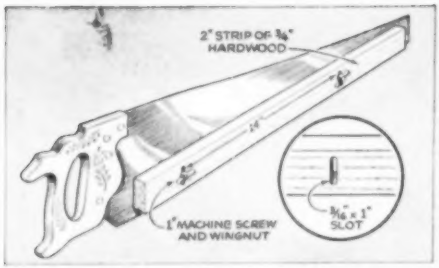
WHEN you want a cookie cutter of a special shape, make your own out of tin-can stock. Jigsaw out a wooden or plastic pattern to the shape you want. Cut long strips of tin plate (big fruit-juice cans are a fine source). Clamp an end of the pattern and the strip in a vise, and use a chisel-pointed wooden block to force the strip around the pattern. Solder the ends together and add a handle. —*H. E. Richter, San Antonio.*

Machine Guides Cutting Torch

OPERATING on the pantograph principle, the machine below is used for contour flame-cutting and for butt welding. As the operator follows the outline of a template, the torch cuts a duplicate from the work. The machine, made by the Krohn Manufacturing and Supply Co., Centerville, Mich., cuts circles up to 24″ in diameter, and straight lines up to 52″, as well as combinations of curves and angles.



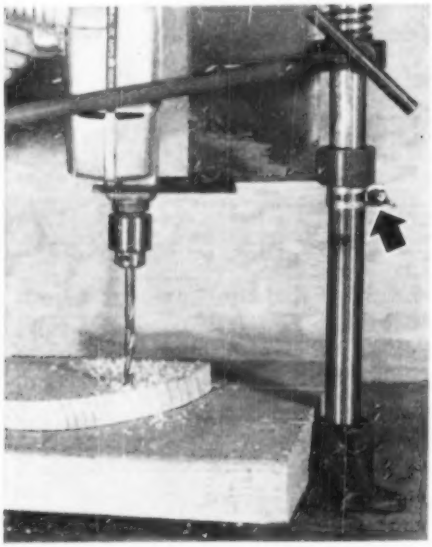




Saw Guide Adjusts for Depth

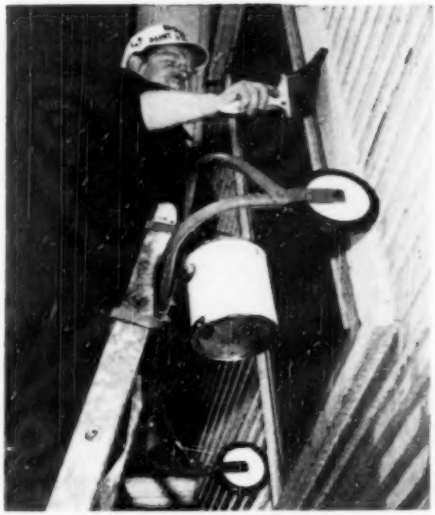
TIRED of using clamps and boards on my handsaw to cut rabbets, I drilled two holes 1½" above the teeth and installed this guide. The slots permit me to adjust the depth of cut up to 1".

A guide is attached to only one side of the saw. This leaves the left side open. A board can be clamped to the work to guide the saw as the cut is made. The two drilled holes do not interfere with normal use of the saw.—*Edgar H. White, St. Paul, Minn.*



Hose Clamp Used as Drill Stop

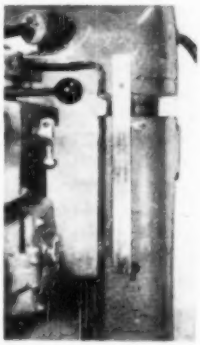
IF THE drill-press stand for your portable electric drill is not equipped with a depth stop, you can improvise one with a hose clamp and wing nut (arrow). Determine the desired depth of hole by bringing the point of the drill down outside the work. Then lock the clamp on the column.—*W. G. Waggoner, Sacramento, Calif.*



Ladder Rolls Up the Wall

A FREE-WHEELING ladder attachment may take some of the labor out of home maintenance. With it, one man can raise an extension ladder up the side of a house easily and accurately. The wheels are mounted on a frame of light steel tubing and spaced to span an average window. Stanley Roketa, an engraver for Minneapolis-Honeywell Co., Minneapolis, invented this Lad-R-Prop and manufactures them in his spare time.

Gauge for Radial Saw



A 12" STEEL rule—screwed or strapped in place—makes a handy depth gauge for your radial saw. The pointer is a piece of sheet brass. If you don't want to take the temper out of the rule to drill it, fasten the scale to the saw with a piece of steel strap.

For best readability, coat the scale with white model-airplane dope. When this dries, sand it off, leaving dried dope in the scale graduations. Then brush clear lacquer or shellac on the scale.

It's not necessary to have the pointer set at any particular point. The idea is to have a reference for duplicating a previous setup. —*Francis Munson, Los Angeles.*

Black Sunshine Keeps Us Warm

A sun deck need not be chilly after dark, if you install glass heating panels.

By Paul Corey

WE CAN enjoy our sun deck for extra hours these fall evenings because electricity holds back the sunset. Here in Northern California the evenings seem to cool off very suddenly. In past years the drop in temperature sent us indoors to bundle up in coats and sweaters. Now we just reach out and turn a switch.

The black sunshine that has added so much extra enjoyment to our deck comes from a couple of glass heating panels. Though they give off no light, these panels act much like real sunshine. Their heat is

Our overcoats are overhead, up under the eaves, and warm us more than they warm the air. There is no visible light from them to attract insects. The rectangular panels, hinged at their outer ends, can be angled to send their rays where they do the most good.

I hinged the panels to the sun-deck overhang and attached pulleys so that I could pull them back up when they're not in use.

radiant, which means that it warms people and things before it warms the air. In an outdoor installation of this kind there is practically no rise in air temperature. But there is a *feeling of warmth*, and that's what counts. The rays spread out in a wide arc and are effective up to about 15 feet.

Glass heating panels are made by Continental Radiant Glass Heating Corp., of New York, and are sold by local distributors in many parts of the country. When I first decided to try radiant heat on my sun deck, I got in touch with my distributor. I was surprised to find that the panels aren't easy to buy. The dealer wanted full particulars of the use I had in mind. He warned me that my application had not been tried and he could not guarantee results.

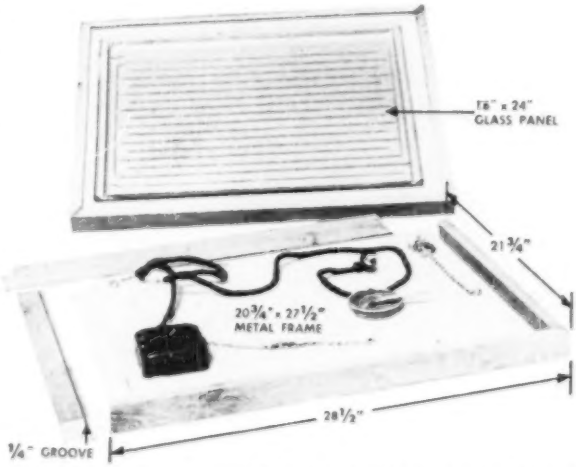
I accepted full responsibility and even pointed out that the units did not have to be very efficient because my electric rate is quite low—it goes down to less than one cent a kilowatt hour. Though my installation has worked out as well as I could have hoped, I mention all these facts just as a caution. Before you buy yourself a dose of glass heat, be sure to consider your climate and power costs.

Having won the dealer's consent, I ordered two 115-volt, 1,000-watt, recessed-type panels at $56 each. They come in metal mounting frames measuring 20¾" by 27½". I built a wood frame from ⅞" by 1¾" strips of redwood, mitering the corners and grooving the edges as shown in the photo below.

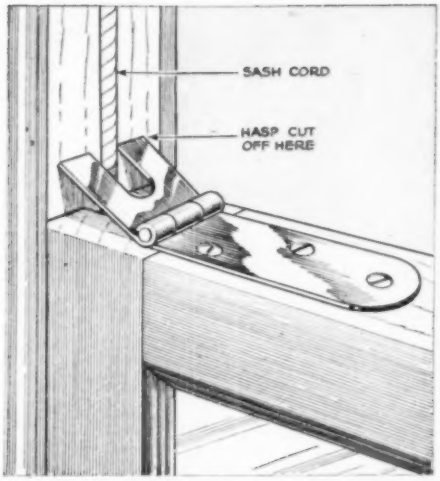
Since the panels draw 2,000 watts, they must be operated off a separate circuit. I rearranged a little wiring in the house so that one 20-amp. circuit would not be required for any other service while the heaters are on.

Next, I hinged my wooden frames to the inner face of the sun-deck overhang, spacing the panels about four feet apart. I also attached a pulley and clothesline to each panel so that I could raise and lower it to angle the rays for best effect. When the panels aren't in use, I can just pull them up under the roof. That way they are not exposed to rain. The panels themselves won't be harmed by moisture, but it's usually a good idea to keep all wiring dry.

The initial cost of this home luxury was high, but I expect to write it off over many years of spring and fall enjoyment. Operation cost is negligible—my bill for two and a half hours of comfort is less than a nickel. That isn't much to pay to be able to sit in the sun after the sun goes down. END



Glass panels come mounted in metal. I built wooden frames to fit the metal. I grooved the strips and mitered the corners.

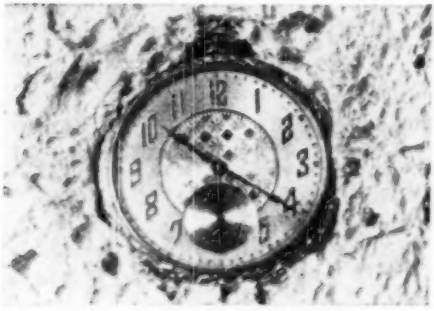


Hasp Is Stop for Window

AN EFFECTIVE safety device that will keep a small child from raising a partly open window can be made from a dime-store hasp. Hacksaw the hasp as shown, file the cut edges sharp, and screw it to the top of the sash. When the altered hasp is in the position shown, any attempt to raise the window will cause the sharpened ends of the hasp to bite into the window frame. When you want to raise the window, fold the short part of the hasp back toward the center of the sash. *—Jesse R. Lucas, Michigan City, Ind.*

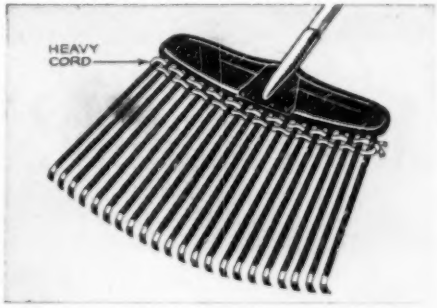
Glass Bricks Easy to Use

GLASS-BRICK panels—not more than 25 sq. ft. in area and not more than 5′ wide or 7′ high—can be installed without elaborate framing. Manufacturers report that on such panels expansion strips at jambs and head, as well as wall ties in the mortar joints, are not necessary. The blocks in small panels are also strong enough to withstand weather extremes.



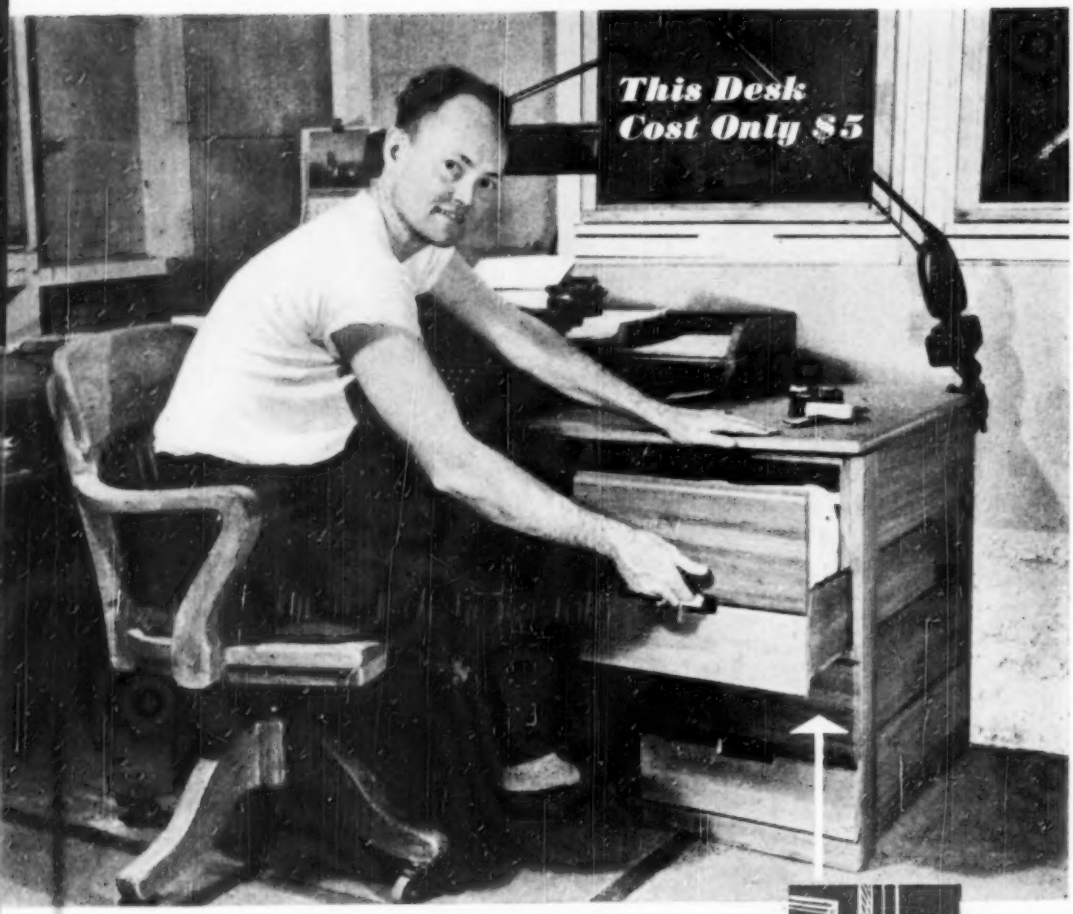
Sponge Cushions Watch

TO SAVE his pocket watch as much as possible from shocks but still have it constantly visible while driving his truck, one driver mounted the watch in a block of synthetic sponge, as above. He keeps the sponge and watch on the ledge above the instrument panel—*H. Klein, Pittsburgh, Pa.*

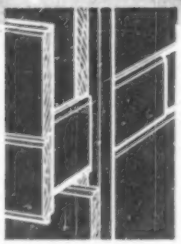


Weave Strengthens Leaf Rake

TO KEEP the spring-steel teeth from breaking off from leaf rakes, weave two or three rows of heavy cord back and forth as shown. This lessens the vibration and prevents concentration of the strain at the point where the teeth enter the rake head.—*W. H. McClay, Pasadena, Calif.*



Need Furniture? Try Shiplap



Anyone can build drawers for sectional units if he uses this inexpensive siding.

By Darrell Huff

AS FAR as I know, this is a brand-new way to build drawers. Certainly, it is just about the simplest and cheapest method you can imagine.

The secret is buying shiplap siding lumber. It has a ready-made rabbet that takes the headache and labor out of making drawer slides. Being construction lumber, it's available everywhere and at a moderate price.

By buying an inexpensive grade of lumber (at about $80 a thousand feet), I built this two-drawer filing unit for just $2. The plywood desk top, the two-by-fours that support the other end of the top, and the nails and lacquer brought the total cost of the desk up to $5.

There's a final touch of rock-bottom economy in the unit. When the drawers are

closed, their sides form part of the sides of the cabinet, avoiding the usual duplication of lumber.

By varying the proportions and dimensions, a similar unit can become a chest, dresser, kitchen cabinet, shop storage cabinet—almost any kind of a storage unit you want.

Which Desk Do You Like?

With one or two of these drawer units, you can work out several different desk designs. The sketches at the right give you four suggestions. The simplest requires one drawer unit. The desk top is supported by the drawers and a two-by-four screwed to the studs of a wall.

Another drawing shows one end of the desk top supported by two-by-fours—as mine is. Build the two-by-four support the exact height of the unit and about 18″ wide.

Two drawer units and a plywood top give you a free-standing office desk.

The fourth variation is more elaborate and highly useful. It provides two desks in one. By swinging to right or left, you have both typewriter and writing desk always at hand. This one also provides two drawer units.

For any of these desk tops, ¾″ plywood is best—especially if you're going to use a standard typewriter on it and if you want the top more than 4′ long. For a shorter top, or for one to hold a portable typewriter, you can get by nicely with ½″ plywood.

You can buy shiplap in pine or fir, but I used redwood because a couple of coats of clear lacquer gives it such a handsome finish. If you want to spend a little more money and turn out a better-looking job, cover the top with linoleum and finish the edges with wood or metal molding.

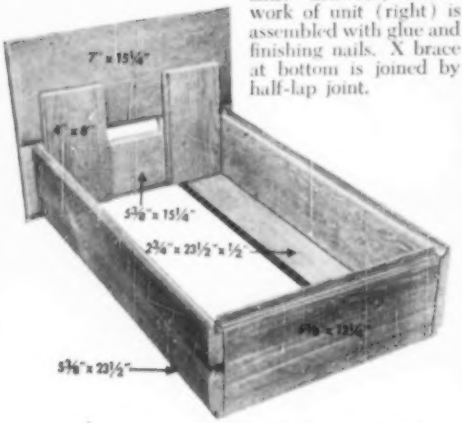
Here's What It Takes

Cost will depend upon the size of desk you build, thickness of the plywood top, and local variations in lumber prices.

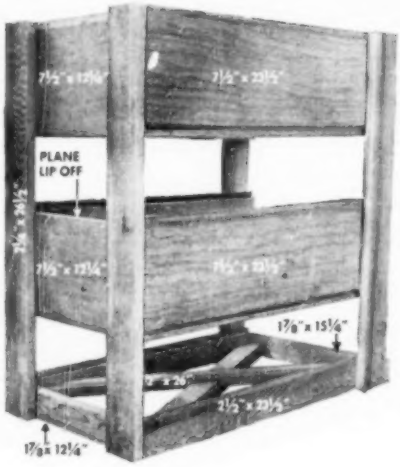
To build one basic drawer unit you'll need:

- 4′ of ½″ by 6″ stock.
- 4′ of 1″ by 10″ stock.
- 12½′ of 1″ by 6″ shiplap.
- 16½′ of 1″ by 8″ shiplap.

In buying the shiplap, get the type that's usually called V-rustic. Get 14′ and 18′ lengths. They will give you margins for discarding sections that have bad knots. You'll note that the ½″ by 6″ stock and the

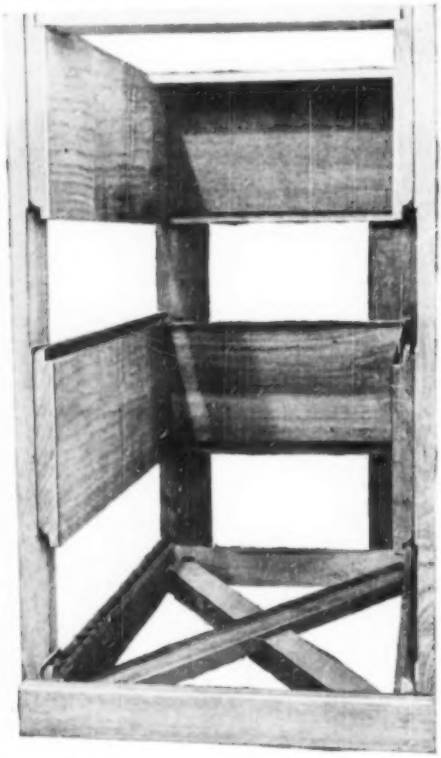


Like drawers, framework of unit (right) is assembled with glue and finishing nails. X brace at bottom is joined by half-lap joint.



Gap can be left in bottom of drawer if it is to hold file folders, or filled in if drawer is to be used for other purposes.

Front view of frame section (below) shows construction details. Note that lip on top of back middle board has been planed off.



one-by-ten are plain lumber—not shiplap.

Cut the 1" by 8" V-rustic into these pieces:

- 2 pieces 12¼" long.
- 2 pieces 15¼" long.
- 4 pieces 23½" long.

Also from the 1" by 8" shiplap, saw two 2½" by 23½" pieces from one edge. Cut these from the edge that has been milled to give the chamfer effect that forms the V joint. As you can see from the photos, this edge is at the top of all pieces in the unit.

From the remainder of the one-by-eight, cut these pieces of plain board:

- 1 piece 1⅞" by 12¼".
- 1 piece 1⅞" by 15¼".
- 2 pieces 2" by 26".

Cut the 1" by 6" V-rustic into these pieces:

- 2 pieces 12¼" long.
- 2 pieces 15¼" long.
- 4 pieces 23½" long.

Cut 26½" off the one-by-ten and rip it into 4 pieces of equal width—about 2¼" wide. From the rest of the one-by-ten, cut four 4" by 8" pieces. Cut the ½" by 6" stock into a 13" and a 23½" length. Rip both down the center.

Now, with all your pieces cut, you'll have a confusing stack of boards. Pick out the following sections for the two drawers:

- All 1" by 6" V-rustic.
- 2 pieces of 15¼" one-by-eight.
- 4 4" by 8" pieces.
- 4 23½" lengths of ½" lumber.

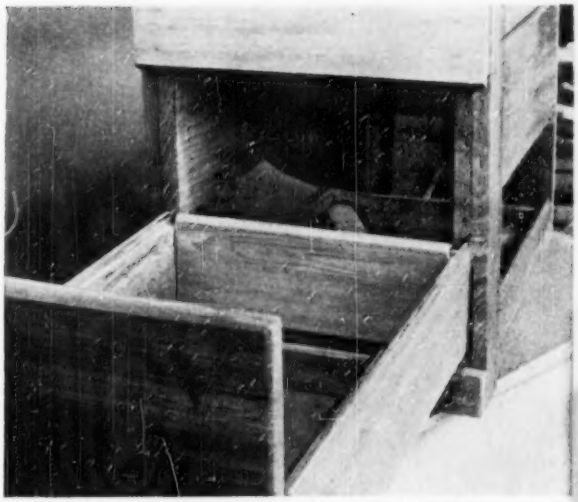
Build the drawers first, assembling them with glue and finishing nails. You'll need them to help in spacing the parts of the

frame. The gap in the middle of the drawer bottoms saves lumber and makes it easier to remove a number of file holders at once. Of course, if you want the drawers to serve as regular desk drawers, you'll have to fill in the gap.

After putting together the bottom of the framework and the four uprights, slip a drawer in place as a guide for exact positioning of the middle boards. Plane off the upper lip of the middle board across the back to let the upper drawer fit flush with the front. Also plane off the upper lip on the front of the bottom drawer.

That finishes your job if your drawer unit is to be part of a desk. If it is to stand by itself as a two-drawer file, you'll want to put on a plywood top.

Finally, sand the wood and give it the finish you want. I used two coats of water-white lacquer, with an extra coat on the drawer fronts. END

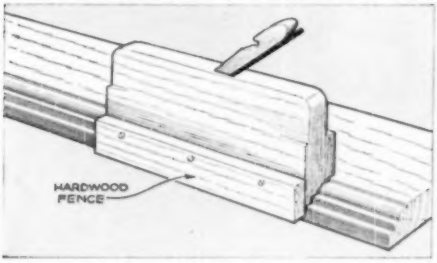


This photo shows how lips of shiplap slide together smoothly to give you ready-made drawer slides for a low-cost desk.

Removing Broken Flash Bulb

WHEN the glass breaks in a used photoflash bulb, you can remove the base from the socket by forcing a cork over the protruding sharp tips. Cork gives a good grip.

Fence Improves Molding Plane



AN OLD-STYLE molding plane becomes a more useful tool if you screw a hardwood fence to one side. This provides a more accurate and precise guide against the edge. *—H. R. Diamond, Glen Head, N. Y.*

Nonflammable Paint Remover

A NEW paint and varnish remover takes the fire hazard out of the job of skimming the old finish off wood or metal surfaces. The remover leaves no residue, so the surface does not have to be washed before it is repainted. Sterling Paint & Varnish Co., Malden, Mass., packs 5F5 Paint Remover in ½-pt. to 5-gal. cans.

Ribs Strengthen Flush Doors

ARCHED ribs, running vertically within a solid lumber frame, support the face panels of a new hollow flush door. Each rib is arched a full 2", providing overlapping support. The elimination of the usual horizontal members in contact with the face panels is said to prevent any "show-through" of core construction in the finished door.

Hardwood veneers and face veneers are crossgrained and hot-press resin bonded to the core. According to the maker, the Haskelite Mfg. Corp., Grand Rapids, Mich., this gives maximum resistance to warping and buckling. The Arch-Kor doors are fitted with lock blocks along each edge and may be trimmed to fit.

"Please get me out of here before noon," Mr. Wilkins pleaded with Gus.

Gus Has A Noisy Day

In quickly diagnosing engine clatter, the veteran garageman also saves a fellow man from equally unnerving chatter. ***By Martin Bunn***

IT WAS one of those clear fall days that Gus Wilson liked. Not down to freezing, but nippy enough to make you feel like doing things. Crisp weather always put Gus in a good humor, and the problems at the Model Garage never seemed quite so bad when you didn't have to sweat over them.

It was a good thing that Gus was feeling the way he did, because right at that moment a shiny new two-door sedan rolled up to a stop, and as the right door popped open Gus recognized the bulbous, overdressed figure of Mrs. Miller, the town's most talkative woman. Anyone had to be feeling chipper to take her.

"Oh, Mr. Wilson," she all but sang, "so glad you're here and not just one of your men. I've brought a customer for you. He's been having all sorts of nasty trouble with his car and I've told him there's no one like our Mr. Wilson when it comes to fixing automobiles."

As Mrs. Miller prattled on, Gus noticed a pleasant-looking, middle-aged man slide out from behind the wheel of the car and walk toward them.

A Long-Winded Introduction

"Tom," Mrs. Miller burbled, "this is Gus Wilson. Gus, this is Tom Wilkins. Tom and his wife are old friends of mine from my old home town. They've been off on a fall vacation trip and stopped by to see Henry and me for a few days. They want to get an early start back tomorrow morning and there's something or other Tom wants done on the car before they leave. Tom, you tell Mr. Wilson about it."

"Well, it's . . ." Tom began, but that was as far as he got.

"Gus does amazing things," Mrs. Miller gushed. "Why, about four years ago we were having all sorts of difficulties with our carburetor, or was it the transmission? Well, anyway, he . . ."

For the next five minutes Mrs. Miller held forth with a story about how Gus once had made a minor and obvious repair on an ancient Rolls-Royce the Millers had owned before they got their present car. Gus, bored, just puffed on his pipe. He knew better than to try and stem the flood of words once Mrs. Miller got wound up.

"Now let's get around to your trouble, Mr. Wilkins," Gus put in at the first lull.

"Well, as I started to say," Tom Wilkins began again, "it isn't much of a trouble, it's just that my hand brake doesn't hold and I don't want to start the trip home without it. I was wondering if I could leave the car with you tonight and pick it up early in the morning?"

"Oh, Tom, I do wish you and Bessie didn't have your hearts so set on such an early start," Mrs. Miller broke in. "I did *so* want you to meet Mrs. Thompson and her two young daughters, and they're coming over for lunch tomorrow."

"What time did you want to get started, Mr. Wilkins?" Gus asked, ignoring Mrs. Miller as best he could.

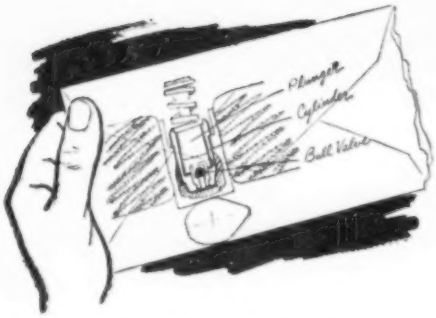
"I'd like to make it around six o'clock if I can," Wilkins replied. "That would put us on the road at about daylight."

"We don't open around here until seven," said Gus, "but I'll tell you what we can do. You park your car over there just beyond the shop doors. I won't need the ignition key, so you can take that with you. I'll fix the brake before I leave tonight and the car will be right there waiting for you whenever you want to leave in the morning."

NEXT morning, when Gus drove up to the garage he was surprised to see Tom Wilkins' car still parked by the shop doors and even more surprised to see the Wilkinses and Mrs. Miller sitting in the Miller's car parked close-by.

Before Gus could get out of his car, Mrs. Miller had her car window down and was shouting.

"Oh, Mr. Wilson, thank goodness you've come. Something terrible's happened to



Tom's car. We've just been sitting here hoping you'd come soon."

Gus now was more mystified than ever. The car was all right when he'd left it.

"What seems to be the trouble?" he asked Tom Wilkins.

"Well, perhaps I'd better go back a few days so you'll have the whole story from the beginning," Tom began, as he and Gus, trailed by the ever-present Mrs. Miller, walked toward the car.

"As you can see, my car's practically brand new. We've only driven it a bit over 3,500 miles, and everything was going along fine on this trip until we stopped overnight at a town about 150 miles south of here. The hotel had no garage, so I had to leave it out overnight in a parking lot."

"How long ago was that?" asked Gus.

"Let's see," Wilkins figured. "We got here last Tuesday, so it must have been Monday night."

"That's right, Tom," chirped Mrs. Miller, no longer able to stay out of the conversation. "You and Bessie got to the house just after dusk. I distinctly remember it because I recall telling Anna, that's our maid, you know, that I did so hope that you'd arrive in time for dinner."

Gus ignored the nonstop chatter and turned to Tom Wilkins.

"Next morning, after breakfast," Wilkins continued, "I went out to bring the car around to the front of the hotel. When I pushed the button she started all right even though the morning was kinda cold, but the engine made a terrific clatter.

"I knew it wouldn't be safe to drive very far with it sounding like that, so I nursed it to a garage I'd seen down the street. The mechanic there listened to it, shook his head grimly, told me to leave it, and that he'd do his best to have it ready for me by noon."

"Did he say what he thought the trouble was?" asked Gus.

"Not then," replied Wilkins. "Come noon, I went back, and sure enough he had the engine purring along just as it should. He mentioned something about valves and said the bill would be $20."

"Twenty dollars?" repeated Gus, questioningly.

"Yep, $20," Wilkins agreed. "I thought it was high too, but you can't argue when you're in a strange town and don't know much about automobiles anyway."

"Tom Wilkins," squeaked Mrs. Miller, "if you take my advice, you'll drive right back through that town on your way home and give that man a good dressing down. I'd demand that he give you your money back. It's disgraceful the way some dishonest garage owners take advantage of the public."

Gus Breaks Through the Chatter

"Well, what happened this morning when you came to pick up the car?" Gus asked. His impatience should have been obvious even to Mrs. Miller.

"The same thing," Wilkins explained. "We got here about six and when I started up the engine it made the same kind of noise, so I shut it off immediately. Here, you can hear it yourself," he said as he slid into the driver's seat and pushed the starter button. There was a distinct rhythmic clatter that sounded like a bad case of valve trouble.

"Tell you what," Gus said, reaching in and turning off the ignition. "There's no sense you folks hanging around here this frosty morning. Why not go back to Mrs. Miller's in her car? When I've got yours ready, I'll bring it over."

On the way over to Mrs. Miller's car, Tom Wilkins edged Gus to one side and pleaded, "Please try to get me out of here before noon. Another meal with that voice and I won't be fit to drive."

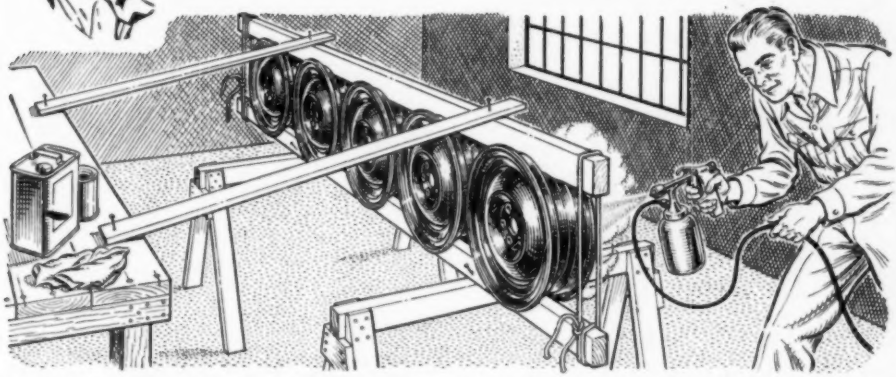
"I'll do my best," Gus promised with a knowing wink.

As Mrs. Miller and the Wilkinses drove off, Gus heaved a sigh of relief. It was almost a challenge to Gus to get the job done as quickly as possible to free Tom Wilkins of Mrs. Miller's endless gabbling—sort of like rescuing a fellow sufferer.

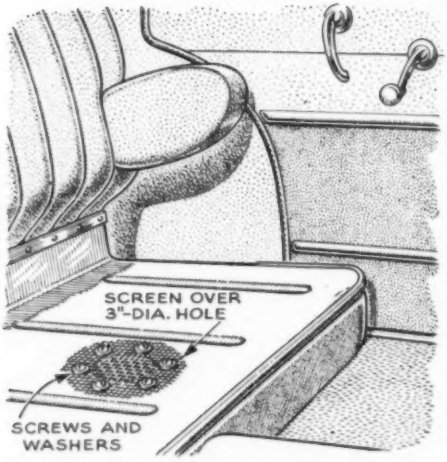
About an hour later, Gus nosed the car into the Miller driveway. Tom Wilkins,

[Continued on page 246]

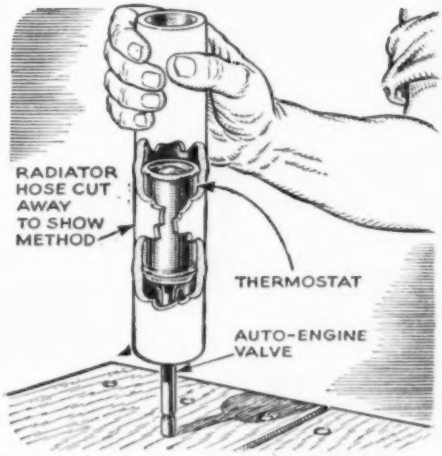
Hints from the Model Garage



Remove Wheels for Spraying. Instead of masking the tires while you are spray-painting a car, Victor Jensen, of Bellingham, Wash., suggests removing the wheels and demounting the tires. Then set up and clamp the rims between a couple of two-by-fours, or other pieces of lumber, by tying the ends with rope. Brace the assembly upright, and you can spray both sides of the rims without difficulty. This method also clears the fenders for unhampered spraying.



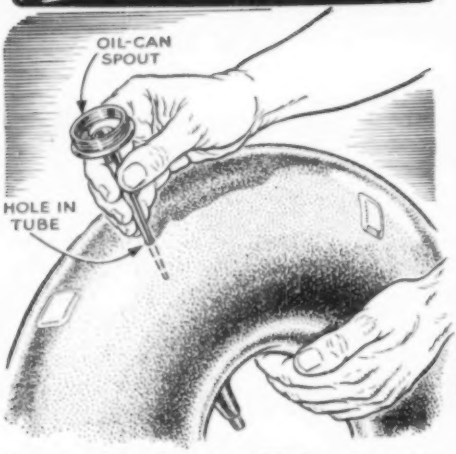
Air Outlet Improves Heater. In some of the newer cars, fresh air is delivered to the passenger compartment while the heater is running. If the windows are closed, air circulation tends to slow up. W. M. Dierks, of Chicago, found that he got improved circulation after placing a screened outlet vent under the rear seat.



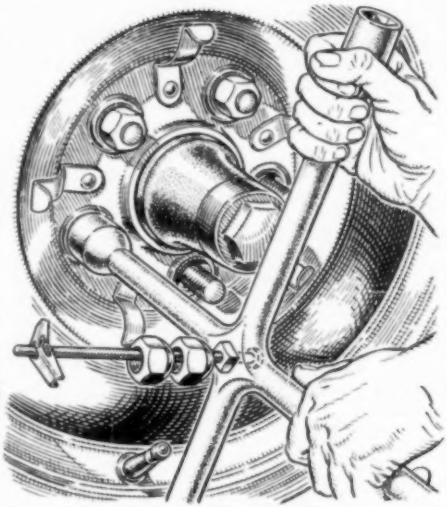
Valve Taps 'Stat in Place. An engine valve makes a handy tool for inserting or removing an inside-hose type of thermostat. Pick a valve that will just fit inside the hose. Push it in until the head rests against the 'stat. Then, with the hose in an upright position, tap the valve stem on your workbench or floor.

Turn the page, please, for four more auto hints.

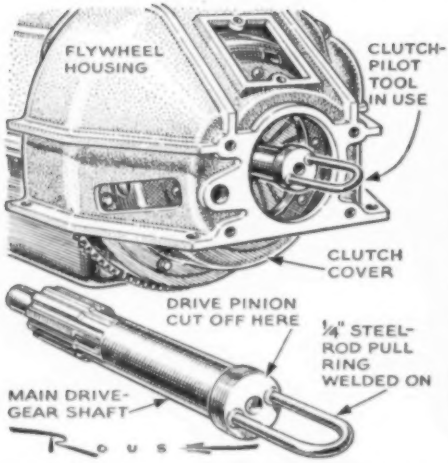
MORE Hints from the Model Garage



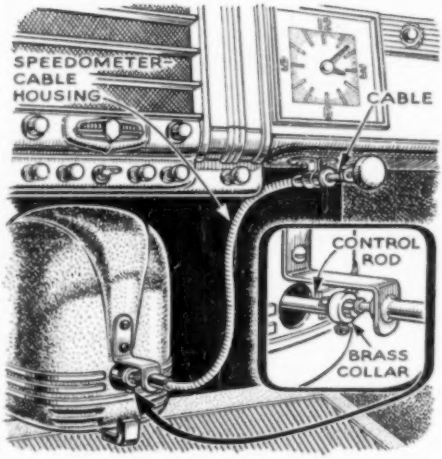
Spout Marks the Hole. John H. Miles, of Springfield, Mo., suggests this trick. When the tube has been pumped up and the leak located, push the oil-can spout through the hole. The tube will deflate and the spout will mark the hole.



Store Nuts on the Wrench. Drill a hole through the center of your four-way wheel wrench and put a toggle bolt in it. As the wheel nuts are removed, they can then be stored on the toggle bolt—safe from getting lost or filled with dirt.



Tool Lines Up Clutch Disk. To assemble and disassemble a clutch, it's a common practice in many garages to use a main drive shaft from an identical transmission as a line-up tool. M. F. Sproule, of San Antonio, Tex., suggests that this will be easier to handle if you cut off the pinion and weld on a pull ring as shown.

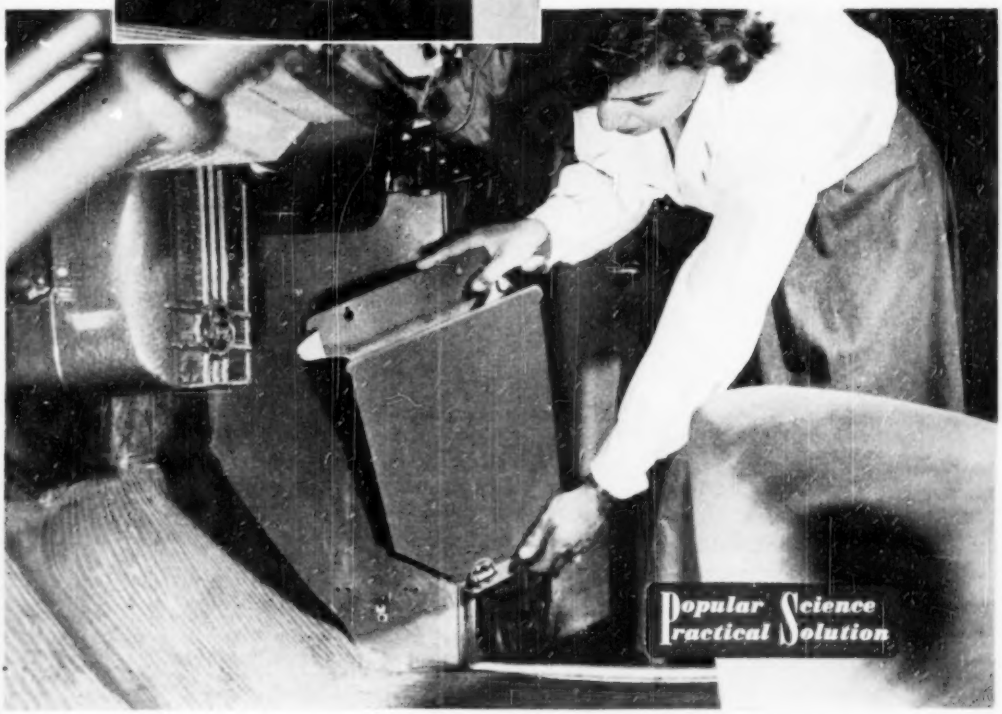


Dash Knob Controls Heater. A salvaged piece of old speedometer cable can be used as a dash control for a gasoline heater. Remove the control knob and fasten it to one end of the cable. Attach the cable to the control rod with a setscrew collar. Pushing or pulling to different positions controls the heater.

Why Litter the Highways?

You can build and install this trash basket for your car in a couple of hours.

By Harry Walton

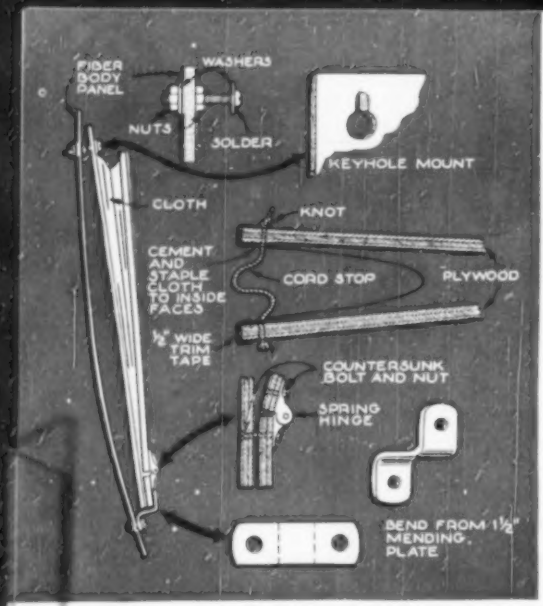


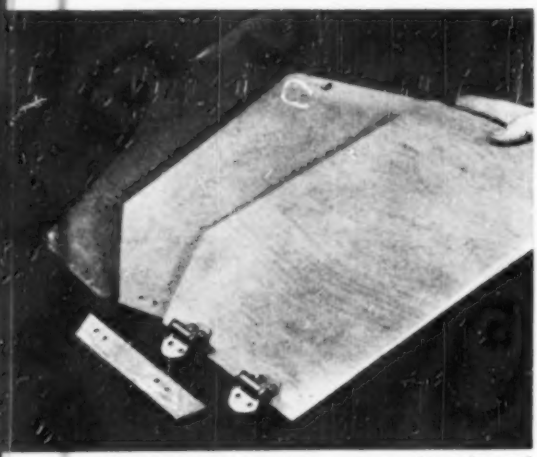
THERE ought to be a law against throwing rubbish from a moving automobile—and in some areas there is. Connecticut's trim parkways, for instance, have signs warning litter hogs to mend their ways. But where can you put the candy-bar wrappers and other scraps?

A wastebasket is the obvious solution. The pictures above, and on the next page, show you how I installed one in a '49 Ford.

The basket is mounted on the panel ahead of the front door. Spring hinges keep it flat when empty. Cloth sides expand like bellows as you stuff in the trash. The entire container lifts out for dumping.

The fiber or cardboard panel that lines this part of a car body can usually be sprung out with a little careful bending and nudging. But before you remove the panel, cut a piece of cardboard to the size and shape





Parts are cut to suit your space. Use plywood for front panel, plywood or composition board for back. Also shown is the fiber body panel.

of the proposed container. Try it in place to make sure the basket will be accessible to your front-seat riders. If you usually drive alone, you may prefer to put the basket on the left-hand side.

Cut the rear or stationary panel of the container the size of your trial template, using 3/16" hard composition board or ¼" plywood. Although offset hinges would be ideal for holding the front and back together at the bottom, the common flush-mounting spring hinges shown will do if mounted on a 1" strip the same thickness as the front. Attach the hinges with 6-32 bolts running through both the stationary panel and the strip, as in the drawing.

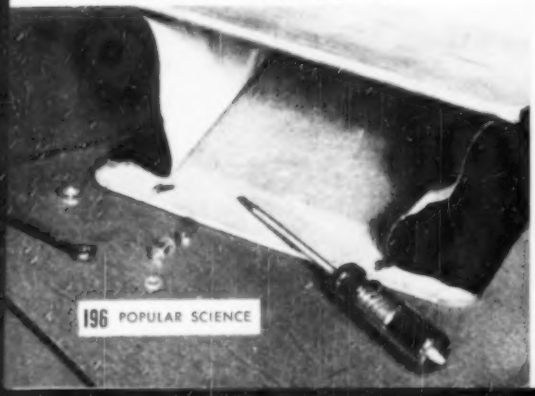
Cut the hinged panel to come a little below the top edge of the rear panel. Drill two holes along the top edge of the back panel and file them to keyhole slots.

Lay the two hinged panels on their side on a piece of oilcloth or other durable fabric, with the top edges about 5" apart, and trace around the edges. Cut out the two long triangles with a ½" margin on both sides. Make a trial fitting with paper clips as shown below.

Insert a block to hold the panels apart when attaching the cloth. A good household cement and an office stapling machine will do this nicely. Fasten the cloth along a ¼" wide "seam" to the inner faces first, so that it has a natural tendency to fold inside. Cloth tape can be used to cover the staples after the panels are painted. Knot through a piece of cord or shoelace to limit movement and prevent tearing the cloth sides.

Mount small bolts with two nuts apiece on the fiber body panel after soldering a small washer under the head of each. To keep the wastebasket from being lifted off accidentally, bend a flat mending plate as shown and mount it below as a clip. END

Cloth on sides folds in, bellows fashion. Keyhole slots in the back panel fit over small bolts mounted in the fiber body panel.



Clip the fabric in place for a trial fitting after cutting to triangular shape. Fabric is both cemented and stapled to plywood back.

How to Make and Fly United Nations' Flag

ANY American can now fly the same flag that the troops commanded by General MacArthur have been fighting under in Korea. The United Nations has amended its flag code to permit the use of its emblem by everyone who wishes to show his support.

The National Grange, the American Farm Bureau, the National Farmers' Union, and many other organizations are now campaigning for more United Nations flags throughout the country.

The white olive wreath around the white globe symbolizes world peace. The background on which this symbol is placed should be Columbia Blue (now United Nations Blue), but don't fuss about the shade.

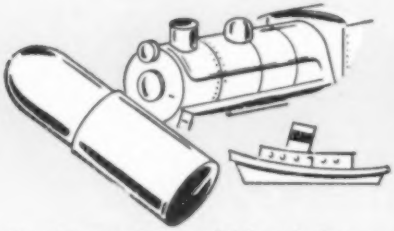
The symbol is shown above on a squared background to help you copy it. It can be painted or appliqued in white on blue. This symbol also can be used to decorate your home craftwork, provided that it is not used for commercial purposes.

It should be flown alongside the American flag in a manner conforming to the laws and customs for displaying Old Glory.

Flag may be any size, but the symbol should be centered both vertically and horizontally, and be just half as high as the whole flag.

Cosmetic Aids for Craftsmen

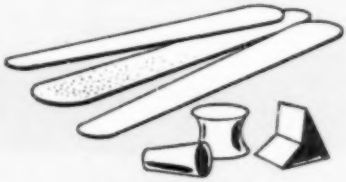
The ladies' vanity tables are full of fine things to have on a workbench.



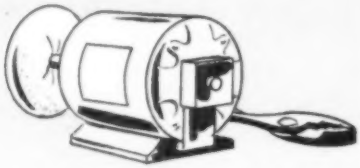
Lipstick tops form model funnels, locomotive domes, caps for edged tools, tanks, and small cylinders.

Mascara brushes will clean internal threads, and also apply cement to narrow edges or in close quarters.

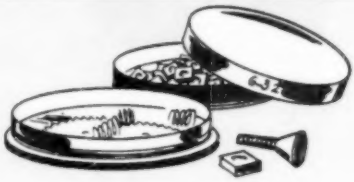
Cosmetic jars have many uses as containers for liquids and pastes. Wash cosmetic out with benzine.



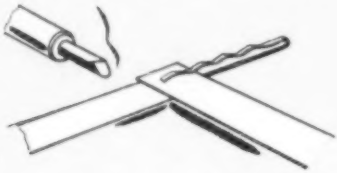
Old emery boards are handy for sanding, shaping, and cleaning small or odd-shaped pieces.



Powder puffs can be punched and mounted on an arbor or motor shaft for extra-fine buffing and polishing.



Flat powder boxes of cardboard or plastic will keep parts safe when you take something apart, and hold bolts, nuts, or the like.



Bobby pins make good small clamps for holding work while glue or cement dries. And they come in handy on soldering jobs.

Nail-polish and perfume bottles have built-in applicators. Clean out old polish with lacquer thinner.

What You Should Know About Horsepower

Auto engines and electric motors are rated in a confusing number of ways, but these home experiments clarify the basic principles.

By Kenneth M. Swezey

WHEN bragging about that new car, are you sure that the horsepower you boast of is power actually available to you? Or are you perplexed when manufacturers recommend either a 1-hp. electric motor or a 3-hp. gasoline engine to do the same job?

Back in the 1780s, when James Watt introduced the term, horsepower meant just one thing: actual power deliverable for useful work. Without limiting adjectives, horsepower means the same thing today. But a dozen or more qualified varieties that Watt never dreamed of are also common. These specialized versions—often useful to the engineer or tax collector—along with different operating characteristics of various engines and motors, may confuse you. To understand what is meant by horsepower, let's start with "power."

How Much and How Fast?

A man can move a ton of sand from one place to another faster than a boy; a horse can move it faster than a man; while an automobile engine can move it faster than a horse. Although the amount of work done in each case is the same, the *speed with which it is done* is drastically different. Technically speaking, we say that the man has more *power* than the boy, the horse more than the man, and the engine more than the horse. Power, then, is the *rate of doing work*.

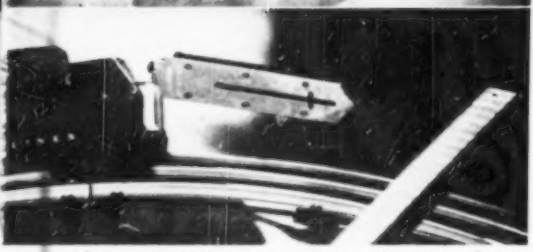
Horsepower is the rate a "standardized" horse does work. In Watt's day, horses trudged in circles at the end of a long pole, operating mill wheels and mine pumps. Watt measured the distance a horse would walk in a minute, measured the pounds of pull on the pole, and multiplied the two figures. He found that a strong dray horse could continuously exert about 22,000 foot-pounds per minute. For good measure he added 50 percent, and declared 33,000 foot-pounds per minute as the mechanical standard of horsepower by which he rated his engines. It is still the standard by which steam engines, turbines, gas engines, Diesels, electric motors, and water wheels are rated.

To find horsepower, all you have to do is to determine the foot-pounds of work a man, animal, or machine can do in a minute, and divide by 33,000. This actual horsepower is generally referred to as *brake horsepower, shaft horsepower*, or *dynamometer horsepower*—all of which mean horsepower delivered at the shaft. Brake horsepower gets its name from the Prony brake, a testing device invented by Baron Prony long ago. It is the horsepower that the layman usually thinks he gets, but often doesn't.

How Many Horses Pull Your Car?

Automobile engine ratings are probably the country's No. 1 source of horsepower misunderstanding. Every auto engine made bears one *taxable* horsepower rating (ranging usually between 20 and 45 hp.) and another *advertised* horsepower three or four times as high—and neither one represents actual power available for driving the car.

Although neither of these ratings represents the true available horsepower of a car engine, they are applied on a fairly consistent basis by all U. S. auto makers, and therefore enable car powers to be roughly compared. In building and testing an engine, car manufacturers deal with at least five



Testing the tractive power of a toy electric locomotive is easy. Mount a ½-inch metal shaft on a weighted wooden block so that it can stand firmly, without turning, in center of circular track. Pass this shaft through hole near end of a 1" by 1" wooden arm, which is just long enough to reach to the middle of the track. Saw a slot from the short end of the arm to the shaft hole, and add a bolt and wing nut to adjust the friction of the arm on the shaft. Attach an 8-oz. or 1-lb. scale between end of arm and rear of engine tender. To find pulling horsepower of engine, let it run at top speed, then tighten wing nut until engine can just keep running smoothly. Now observe pull shown on the scale and count number of times locomotive circles track in a minute. Horsepower equals circumference of track (in ft.) times pull on scale (in lbs.) times revolutions per minute, divided by 33,000. This set-up is very similar to the one Watt used for his original calculation of horsepower.

varieties of horsepower. Here is an example for a typical heavy car:

Indicated hp.	192
Friction hp.	32
Brake hp. (gross)	160
Brake hp. (net)	142
Taxable (S.A.E.) hp.	40

Indicated hp.—of interest chiefly to design engineers—is the total horsepower developed inside the cylinders, including that needed to drive the engine itself. It gets its name from the "indicator," a device used for charting the changes of pressure during the explosion stroke of the pistons.

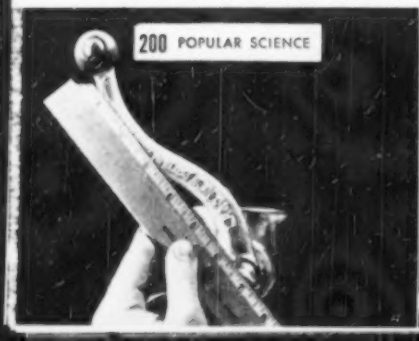
Friction hp. is horsepower lost. It is used up as heat, from friction in crankshaft and cylinders, and represents approximately the difference between *indicated hp.* and *gross brake hp.*

Gross brake hp. is the *advertised horsepower*, and is usually the only actual horsepower rating known to the car owner. Although it is output horsepower of a sort, it is determined with fan, generator, starter, water and fuel pumps, and other accessories removed. Because the horsepower consumed by accessories may vary between 10 and 20 hp. in different cars, two cars of the same advertised hp. may have as much as 10 hp. difference at the clutch.

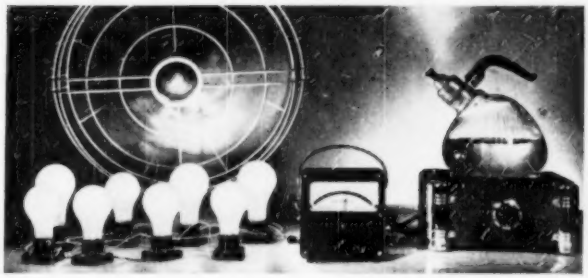
Net brake hp. is the actual horsepower available at the flywheel or clutch, with all accessories operating. This is the maximum horsepower available to drive the car. It is seldom advertised, but can be obtained by asking the car maker.

Taxable (S.A.E.) hp. is merely a pencil-and-paper horsepower worked out some forty years ago by a predecessor of the Society of Automotive Engineers. As the formula is based on a piston speed and cylinder pressure since far exceeded, taxa-

Your arm horsepower can be determined with a meat grinder, ruler, spring balance, and watch. Measure length of the grinder arm, and multiply by 6.28 to find the circumference. Tighten the nut on the grinder until it takes about 20-pounds pull to turn handle steadily. Then—while a friend clocks revolutions—turn as fast as you can for a minute. To find your horsepower, multiply circumference (in ft.) by pounds pull by r. p. m., and divide by 33,000. You're a real he-man if you develop more than 1/10 hp. by this method. In a spurt of running upstairs, a man might develop over 1 hp., but he couldn't keep it up for long.



Electrically speaking. 1 horsepower equals 746 watts, or .746 kilowatt. On each side of the wattmeter is an example of what can be done with 1 horsepower of electricity. To the left it runs five 60-watt bulbs, three 100-watt bulbs, and a 16-inch fan. To the right, 1 horsepower merely boils a kettle of water on a single hot plate. It takes a good deal of power to make heat from electricity.



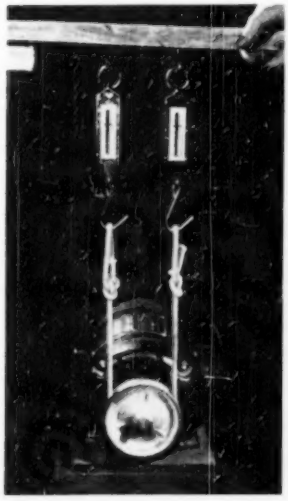
ble hp. does not represent the real horsepower of modern engines at all. It is still used, however, for licensing purposes.

During the last few years, hot-rod enthusiasts have found out that even horsepower delivered to the clutch does not fully determine speed over the road. Transmissions and wheel friction eat up power, too. These fans, therefore, go after *rear-wheel hp.*, a species which can now be tested by dynamometers of tune-up stations all over the country. On a car of 160 advertised hp., rear-wheel hp. might run about 110.

Rated hp. is a term often applied to stationary gasoline engines and electric motors. It means brake hp. that can be exerted *continuously* without overheating. For driving machines that start easily and run smoothly, motors and gas engines can substitute for each other on a basis of equal rating. On machines that have high starting resistance, or are often momentarily overloaded, however, a gasoline engine may need two or three times the rated hp. of an electric motor to give equal performance.

This seeming paradox results from a basic difference between gas engines and motors. A gas engine is a self-contained power plant; an electric motor is really a transformer of power that is supplied from outside. If a tough job overloads a laboring, ungoverned gas engine more than a few percent, the engine may stall. Short overloads on an electric motor, on the other hand, may cause the motor to develop two or three or even more times its rated horsepower, merely by drawing more current from the line.

The relationship between *horsepower* and *watts* or *kilowatts* is sometimes confusing, too. Although we usually think of watts and kilowatts as purely electrical terms, these units are really *general units of power* in the metric system, and as such may readily be converted into horsepower units in the English system. One horsepower equals 746 watts, or .746 kilowatt. END



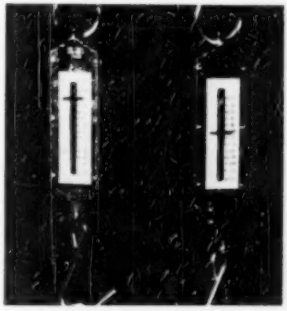
Simplified Prony brake will test horsepower of electric motor. Loop a length of sash cord over a large V pulley on the motor shaft, and support the ends of the cord from two 25-lb. spring balances, hung from a stout stick.

To make test, rest one end of stick on a firm support and bear upward on the free end. When motor is still, both scales read the same (left); when it is running, friction between rope and pulley causes one scale to read higher than the other.

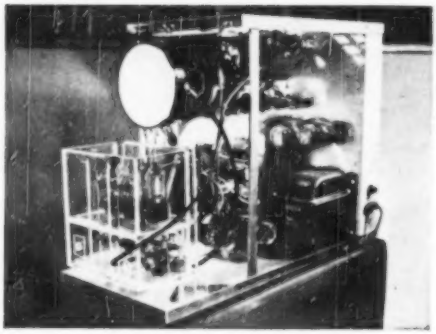
To find maximum horsepower developed at normal speed, raise stick until motor begins to slow down, then allow it barely to regain speed. Note the readings on the two scales, and calculate horsepower using this formula:

$$HP. = \frac{\text{Circum. of pulley} \times \text{pull on rope} \times \text{r. p. m.}}{33{,}000}$$

Circumference should be in feet; pull on rope is the difference between the two scale readings, in pounds. If you have a tachometer to count r. p. m., you can use this simple apparatus to find the horsepower of a small gasoline engine, or of an electric motor running at *any* speed.



Projector Expands TV Picture to Theater Size

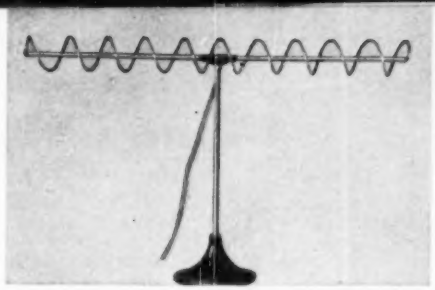


WHEN attached to any television receiver, this portable unit will flash pictures up to 9′ by 12′ on a large screen. It's a 21-tube projector with its own power source, sync and sweep circuits. It can be attached to the receiving set by one wire and used up to 100′ away. Pictures may be viewed simultaneously on the receiving set and the screen, but the quality of each picture is adjusted separately. One receiver, which may even be a little 3″ monitor set, can be used to drive any number of projectors. Its maker, Snaider Television Corp., Brooklyn, N. Y., calls it a "Portojector".

Flying Saucers? Nope, Toy Helicopters

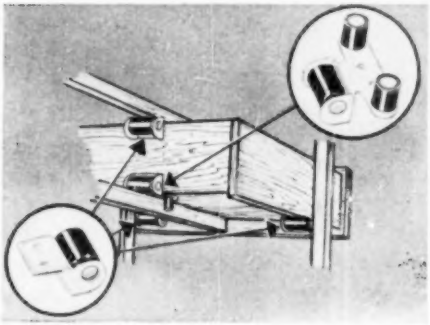
THE gyro top, left, winds up on a spring winder like an old-fashioned metal singing top. But instead of pressing down to release the top to spin on the floor, you press upward and the top spins toward the ceiling, then glides to the floor. The gyro top is sold by F. A. O. Schwarz, New York toy store.

An aerodynamic engineer, Ken Crowder, devised the much larger plastic helicopter on the right. A string is wound top-fashion on a hub under the rotor. By pulling hard on the string, the rotor is made to spin fast enough to lift the toy above the tree tops. Because it is flexible, it won't break if it crashes into something. It is distributed by the Gillmore Sales Co., New York City.



Spiral Antenna Saves Space

THIS new TV antenna saves space by spiraling its long low-frequency arms around the short, straight high-band dipole. The unit stands 20″ high and measures 32″ across. Hi-Lo TV Antenna Corp., Chicago, makes the antenna in both indoor and window models. It retails for about $10.

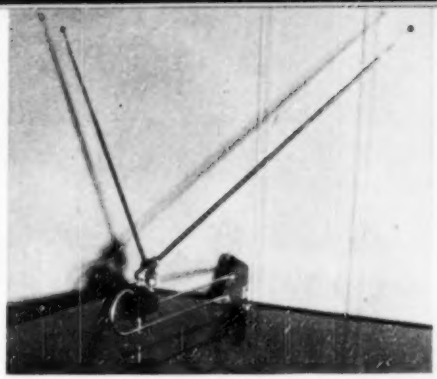


Rollers Unstick Wood Drawers

TIGHT, hard-moving wooden drawers will work more smoothly when fitted with the set of guide rollers above. The Roll-eez bearings, made by Junior-Pro Products Co., St. Louis, Mo., can be easily attached to most drawers. A set sells for 45 cents.

Tiny Photocells Drive Relays

THE germanium photocells below are hardly larger than the head of a match, yet they have enough electrical output to operate relays without the help of electronic amplifiers. The tiny cells, developed by Sylvania Electric, take advantage of the photosensitivity of germanium to turn very small changes in illumination into relatively large changes in electricity. Each cell is made by sealing a small chip of germanium and a fine wire "whisker" in a solid piece of plastic. The plastic acts as a protective shell and forms a light path to the point where the whisker contacts the germanium.

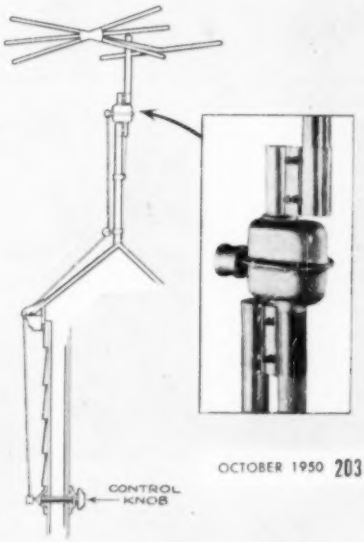


TV Antenna Folds Behind Set

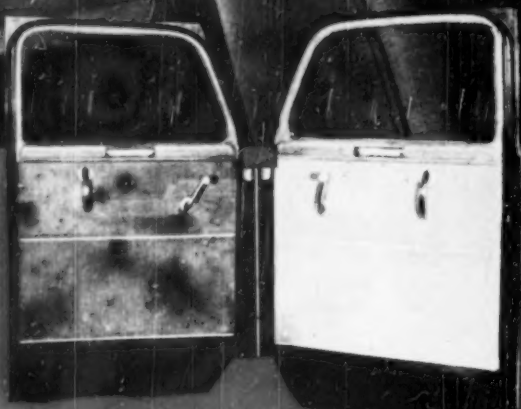
INDOOR television antennas never add to the beauty of sleek cabinets. But this one, called the Hideaway, folds out of sight behind your set when not in use. It's manufactured by the Channel Master Corp., Ellenville, N.Y., and sells for about $9. Wooden parts come in blonde, walnut, or mahogany.

Antenna Rotated by Hand

YOU supply the muscle and the Tele-Turner below swings your TV antenna around to face the station. This nonelectric rotator is connected by pulleys and wire to a manual control inside the house. It's made by the Joseph Shaw Company, Toledo, Ohio, and sells for $16.45.



Spraying the headlining as above is one of the new procedures now available for sprucing up the inside of your car. The spray, a product used by many dealers, makes the fabric look new. A fan is recommended to carry off vapors.



Dirty door panels can be cleaned with the same spray. An extreme before-and-after example is seen above. The spray material used was Plastictint. It is for use on door, side, and headlining fabrics only, not the seats.

Spraying steering wheel makes it look better. One Ford shop does job as at right, shielding windshield and instrument panel with cardboard and masking column and shift. Another way to do it is shown on a following page.

Inside Stuff for Your Car

Cleaning and spraying the fabric with a couple of new products brings back that showroom look.

By R. P. Stevenson

FROM outside, the used car looked *very* good. A few chips in the paint, a dent or two—but nothing you couldn't remedy in a couple of minutes

Plainly interested, the prospective buyer waved to his wife, standing near a newer car down the line. "Take a look at this one," he called.

Pulling open the door, she glanced inside, then immediately turned away.

"No," she said, "it won't do. Come on, let's go."

This incident is related, not as proof that some husbands are henpecked, but to show why most dealers devote a lot of time to the upholstery, steering wheel, carpet, floor mat, and other inside features when they recondition a used car. They know it pays.

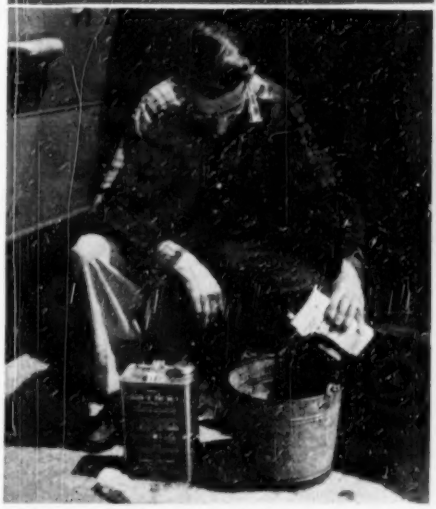
In this, as in sprucing up the exterior, dealers are now using several new products and procedures. At least a couple of these will soon be available at your local auto supply stores—and you can use them, too.

In the dealers' shops, a spray gun is a more important tool than it used to be. You'd expect that a mechanic might spray the body, but when he turns the gun on the interior fabrics, you'll probably want to know what's up. Actually, the spray is a tinted coating that hides faded and soiled areas without leaving the fabric stiff.

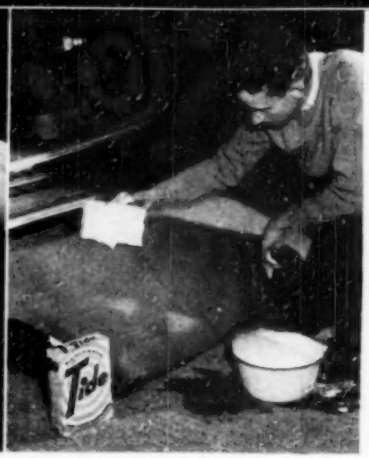
Two of these products are now available to dealers. One, called Spray Tint, is part of a 21-point appearance-reconditioning program promoted by the R. M. Hollingshead Corp., of Camden, N. J. It comes in brown, taupe, and blue-gray colors and can go on any fabric.

The other, Plastictint, is for the headlining and door and side panels only. Developed by Arndt-Palmer Laboratories, of Melvindale, Mich., it will eventually be available

New Cleaner Tints Upholstery

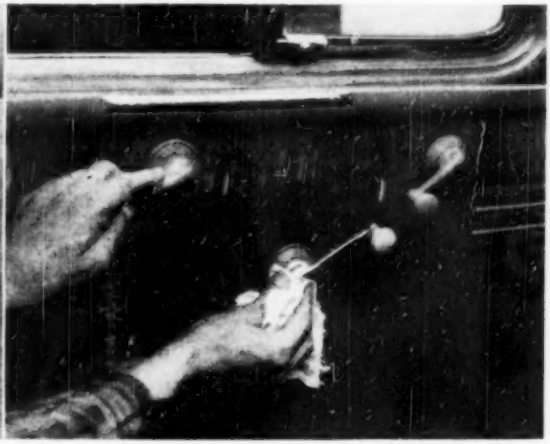


Faded areas in seats and back rests can be renewed with a liquid that tints the cloth while it cleans. It's mixed as above—first, about 8 ounces of detergent cleaner from the large can in a gallon and a half of water, then enough of the tinting solution to give shade desired. To apply it, you scrub a small area at a time (below), without soaking cloth, and at once rub area dry with soft cloth or toweling.



CLEANING

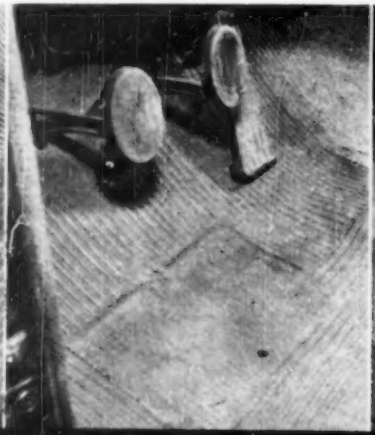
Your first step in renovating the interior of your car should be to clean it thoroughly with a vacuum and a whisk broom. Then remove grease and other spots from the fabric, referring to your operator's manual for tips on cleaning various kinds of spots. If upholstery isn't torn, scrubbing with household detergent may be all that's needed to put it in top shape.



SPRAYING DOOR

In spraying Plastictint, you have to mask only the bottom window molding and door jamb. Two coats are all you should apply, the first one crosswise and the other up and down. When you have finished, a cloth soaked with gasoline or lacquer thinner quickly removes all spray from the hardware. A pint of spray is enough to cover all the door and side panels.

A rubber patch, cemented in place, will cover holes in floor mat under the driver's heels. These are available at supply stores. You may also want to install new pedal pads. Cost is low. Then brush on rubber dressing. The same black that you use on the tires will serve. Dealers can get a brown dye for brown mats, but this is not commonly available at retail.



FLOOR MAT

for public use. Meantime, you may be able to beg or buy some from your dealer. It comes in several colors.

Before applying this spray you should brush and vacuum the fabric and then remove grease spots and darkened edges with a spot cleaner or lacquer thinner. Otherwise the dark areas may show through.

For best results, the manufacturer recommends that Plastictint be sprayed with an air pressure of 75 to 85 pounds. However, you can get by with something less than 50 pounds. Two light coats are enough. If sprayed too heavily, the material may remain tacky.

For cleaning soiled seat upholstery, Arndt-Palmer produces a detergent cleaner to which you add a tinting color. Called Kleen 'N Tint, this is now being marketed in a home-size kit that contains several other items for refurbishing the interior of a car. The kit sells for about $4.75.

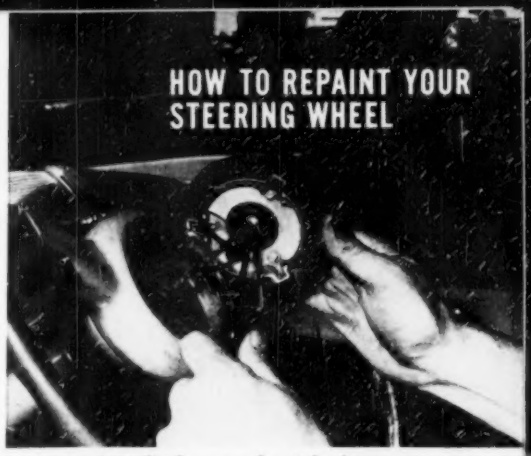
Kleen 'N Tint consists of two liquids, separately packaged. The first is a cleaner and can be used alone for scrubbing the headlining. For the seats and side panels, you mix the first liquid with water and then add a little tinting solution, either taupe or blue-gray.

If the upholstery is badly worn and torn, a dealer practically always slaps on seat covers—and this is the best way out for you, too.

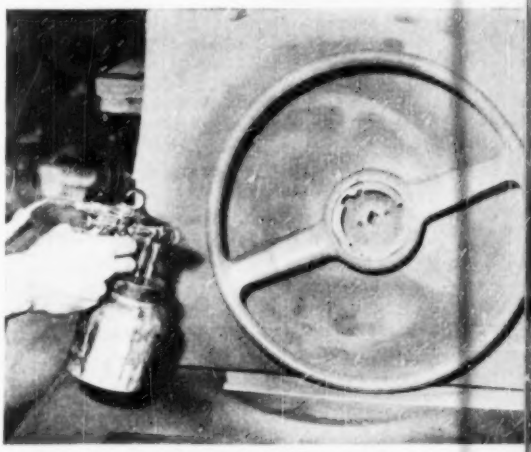
But if the fabric is in good condition, go over it with a good spot remover after surface dirt has been brushed and vacuumed out. Refer to your operator's manual for tips on removing various kinds of spots.

A good scrubbing with a household detergent may then restore the upholstery to top condition. Whip up a lot of suds and ap-

HOW TO REPAINT YOUR STEERING WHEEL

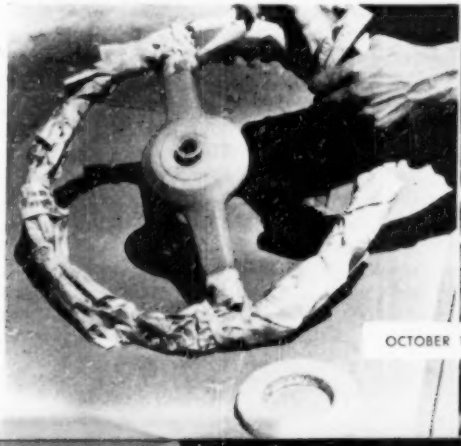


Remove wheel for best results. Job shown was done on '41 Ford. After disconnecting battery, remove horn button by pushing down and turning counterclockwise. Disconnect the wire.

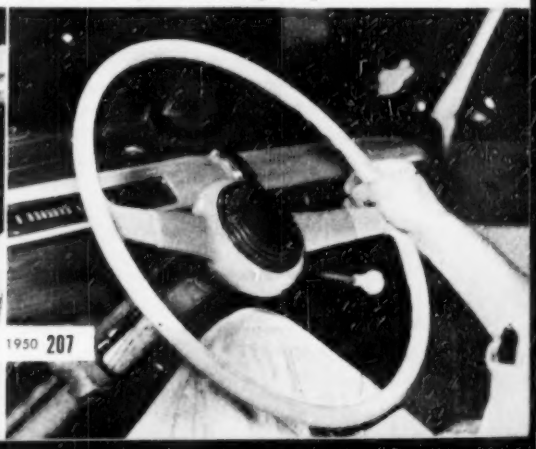


Spray on a medium-heavy coat of lacquer primer after removing old paint with No. 240 waterproof abrasive paper, dipped in thinner. Smooth with No. 360 paper. Let primer dry half hour.

If you want two-tone effect, mask rim after you have given it five or six coats. Spray three or four darker coats on spokes. This is enough here, for spokes get less wear.



Result is worth the effort. Keep all the color coats thin except the last and allow 10-minute drying intervals. Spray final coat fairly heavy. After a few days use rubbing compound.



Flocking luggage compartment gives the effect of carpeting. Many dealers do it—and you can too. Adhesive is first brushed on. Immediately thereafter, a flock gun is used to blow on a heavy coat of the flock. The excess is later brushed off. Above demonstration was arranged by the Chrysler Motors Parts Corp. Entire trunk is often flocked, sides as well as floor.

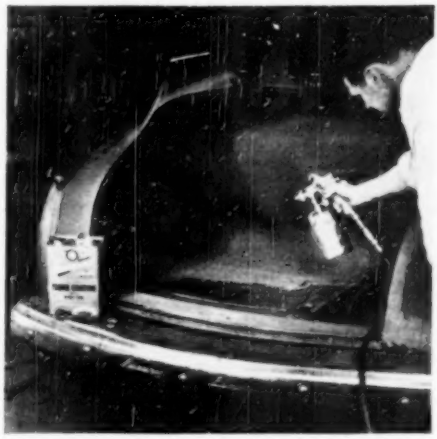
ply these only, using a sponge or scrubbing brush. But for badly faded areas, either Kleen 'N Tint or Plastictint is your answer. A household detergent is also a good bet for a dirty carpet.

A pre-wax body cleaner will often work wonders on the instrument panel and window moldings. Follow this with either liquid or paste wax. Also polish the interior chrome.

It's possible to regrain worn areas on the instrument panel and molding, but because of the expense and time involved dealers frequently just slap on a matching solid coat. This is a good out for you, too.

Cracks and pits in a steering wheel can be filled with metallic putty, now widely used for body repairs. While reconditioning a used car, a dealer may spray a coat of lacquer on the wheel after proper masking. The procedure suggested in the accompanying photos, however, should yield a better job. To remove the wheel, you will require access to a wheel puller. Your garage may help you out.

Flock can be applied with good results to many parts of your car. The luggage compartment, kick panels on the doors, armrests, sun visors, glove compartment, and rear package shelf are all good possibilities.



New trunk coating developed by R. M. Hollingshead Corp. contains cork to reduce noise and looks like leather when sprayed on. It is now being marketed, however, only to car dealers.

Use a carpet type of flock in the luggage compartment, on worn carpets, and on kick pads on doors. This can be sprayed with an air pressure of 40 pounds, but the gun should have an extractor to remove moisture from the air or the flock may lump.

Upholstery flock sprays well at 30 pounds pressure. A good spraying distance is about 12 inches. Use the same technique as in spraying paints, moving the gun steadily in straight lines. If flock becomes damp, place it in a shallow pan in an oven at not above 150° F. END

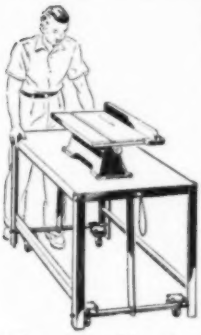
NEXT MONTH . . .
How to Make Seat Covers

You can make your own from the best material for about $7. Also, tips on installing ready-made covers.

Power Tools Can Ride On Retractable Casters

Using this cable-control system, you can move heavy shop equipment with finger-tip ease.

By Bob Gilmore



RETRACTABLE casters make it easy to move a power-tool bench around the shop. Those shown here were installed on a Shopsmith bench in an afternoon, at a cost of about $5. The same idea can be adapted to practically any bench.

To move the tool, you pull out and hook a looped cable at each end of the bench. This depresses the casters until they raise the bench. To lower the bench to the floor again, you simply unhook the two cables.

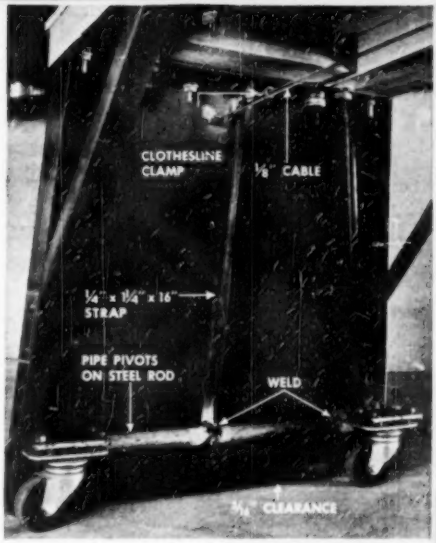
Each cable controls the two casters at the opposite end of the bench. One end of each cable is attached to a vertical lever welded to a pipe that is free to turn. The casters are clamped to short steel straps projecting horizontally from the pipe.

Assembling the parts. In one end of each long strap, drill a hole just large enough to admit the pipe. In the opposite end drill a 3/16″ hole for the cable. Slip the strap over the pipe, center it at right angles, and weld in place.

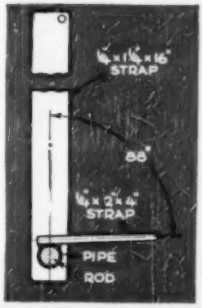
Now weld two of the 4″ straps to the upper side of each pipe ¾″ from the ends. Be sure these straps are at right angles to the longitudinal axis of the pipe. And be extra sure that the angle they form with the long strap is 88°, rather than 90°. Otherwise, the casters won't be perpendicular to the floor when they are in rolling position.

Next, drill holes in the 3″ straps to match those already in the mounting plates on the casters. Clamp the casters to the 4″ straps with short machine bolts. (Clamping them this way, rather than bolting them, lets you adjust the lift and swivel clearance.)

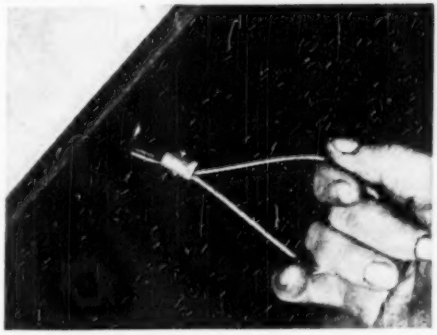
Attaching to the bench. Block the



A vertical lever turns pipe and lowers casters when cable is pulled. The 4″ straps that support the casters must be welded on pipe to form 88° angle with the vertical lever.



Pulling cable as below moves the casters at opposite end of bench. **The clothesline clamp** catches in keyhole slot and keeps bench raised.



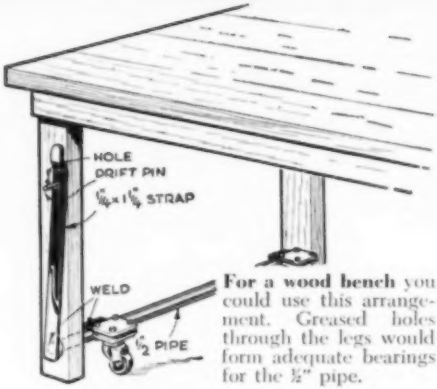
MATERIALS LIST

- 2 pc. ½″ steel rod 18½″ long.
- 2 pc. ½″ water pipe 17½″ long.
- 2 pc. ¼″ by 1¼″ steel strap 16″ long.
- 4 pc. ¼″ by 2″ steel strap 4″ long.
- 4 pc. ¼″ by 2″ steel strap 3″ long.
- 4 ball-bearing casters, 2″ wheel with flat mounting plate.
- 2 pc. ⅛″ steel cable 6′ long.
- 4 clothesline clamps, sleeve-and-setscrew type.

bench ends 3/16" off the floor and locate the holes for the ½" rod on which the pipe pivots. (Pipe in ½" size has an actual inner diameter slightly greater than ½".) Use a level to get the caster plates horizontal while the hole positions are being determined. Weld the rods in place.

Drill cable holes. These should be large enough to pass one of the clothesline clamps. File to a keyhole shape. Then attach the cables to the levers and pass the free ends through the keyholes.

Adjusting the cables. Remove the blocks that held the bench ends off the floor. Form a loop in the free end of each cable, using the two remaining clamps to hold the loops. Now pull the cable through the keyhole until the casters raise the bench 3/16" off the floor again. Hold it there and mark (with a soft pencil) exactly where the cable passes through the keyhole. Then loosen the clamp and slide it on the cable until its inner end is at the mark. Tighten the clamp firmly. END



For a wood bench you could use this arrangement. Greased holes through the legs would form adequate bearings for the ½" pipe.

Renewing Car Upholstery

MOHAIR upholstery in a car may eventually mat down. If so, place a damp cloth over the matted area and run a hot flatiron over the cloth. Then brush the nap upright.

Here at Last Is Use for Knots

Finished tray can be used for candy, nuts, or canapes. To make the handle, knock out a knot from a piece of wood. Carve handle freehand.

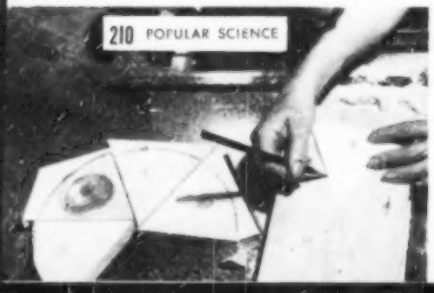
WOOODWORKERS usually shy away from knotty stock, but in this tray the more knots you can include the better. It consists of pie-shaped sections of ¾" pine, each with a knot. Perhaps you can rescue enough scrap for the job. If you buy material, ask for No. 3 or No. 4 grade. That'll give you plenty of knots.

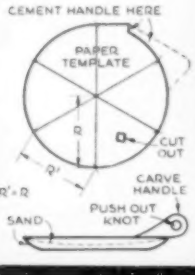
After cutting a paper template as shown in the drawing, lay it on your wood with the hole centered over a knot. Adjust the template so the grain will run from the curved edge to the point.

Glue the sections together. When dry, hollow out the concave face with a coarse garnet or aluminum oxide disk. For finishing, use medium and then fine paper.

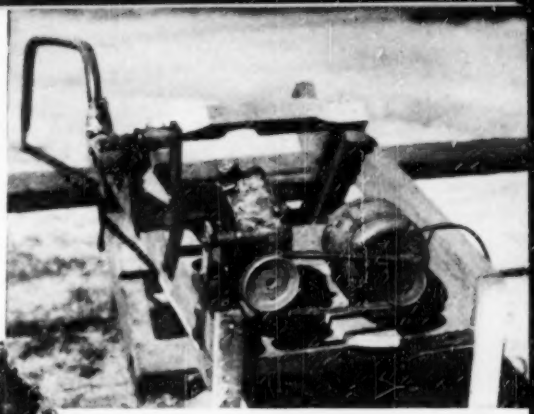
Trim the perimeter with a coping saw and use the sander to bevel the underside. Apply two coats of clear shellac, with light sanding between. Wax completes the job. —*George Daniels, Glenville, Conn.*

Cut pie-shaped wood segments, each including a knot. Use a paper template made as shown in the sketch. First, draw a circle of diameter desired for the tray. Then step off the same radius around the circumference. This gives six identical segments. Clip out one and cut a hole two-thirds of way from point as guide in locating knot. Sand out the tray as below.





Reciprocating action of washing-machine transmission draws saw back and forth as you hold log. Saw is mounted outside the framework.



Washer Gears Saw Firewood

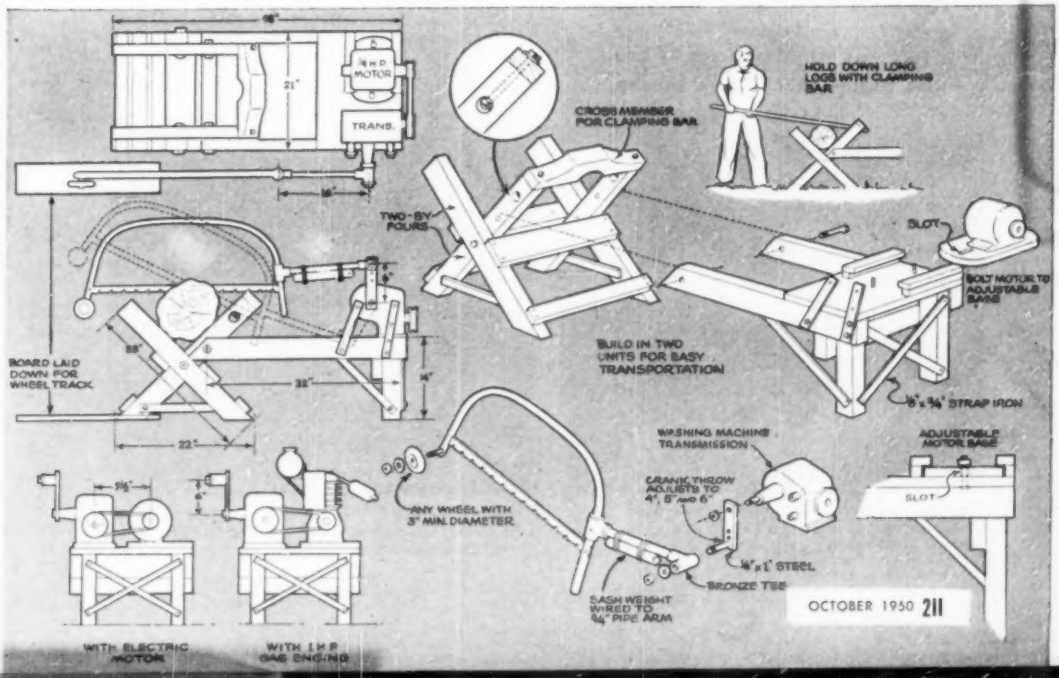
CUTTING a winter's supply of wood will be much less work if you add power to your bucksaw. Here's how it was done by T. C. Garstone, of Altadena, Calif.

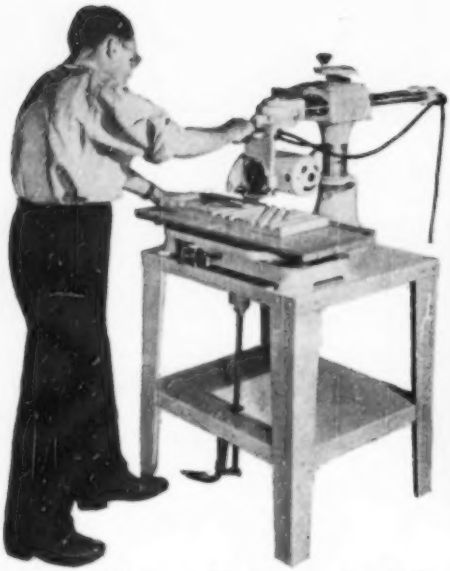
To assemble his outfit, he bought a secondhand washing-machine motor and transmission. The transmission is ideal for sawing since it combines a speed reducer with a push-pull action. Garstone says the saw cuts through a log faster than a husky adult could do it by hand.

The sawbuck and engine mount were built as separate units and bolted together. This makes it easier to move the outfit.

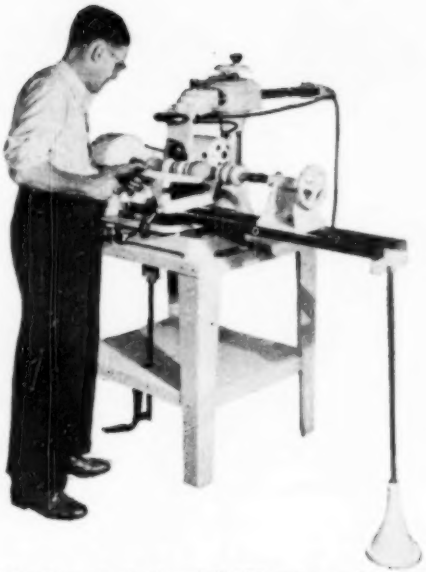
His motor is mounted on a sliding base so it can be moved to adjust belt tension. The crankpin can be set in one of three positions, varying the stroke to suit the kind of wood being cut. When a log is cut, the saw drops and the wheel on its end rides back and forth on a board until the power is shut off. A sash weight on the connecting rod gives the saw more bite.

Where electricity is not available, a small gas engine could be substituted for the motor.—*Hi Sibley, Nuevo, Calif.*





Dadoing. Basic unit is 8" saw, shown here with dado head in place of blade. Long stock can be plowed by changing motor position.



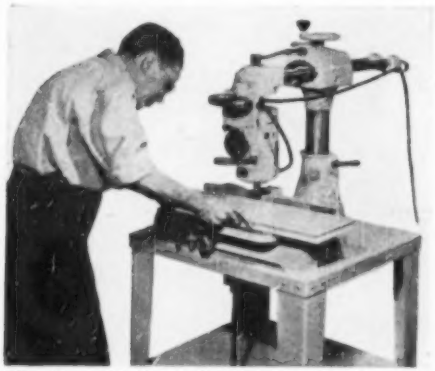
Turning. Lathe has full 10" swing and is 36" between centers. Ball-bearing power take-off, belted to motor, provides various lathe speeds.

Radial Supersaw Tackles All Jobs

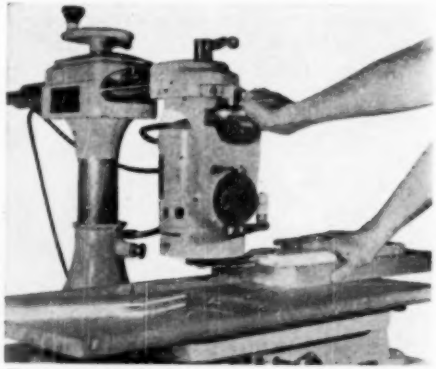
New tool for woodworkers is built around high-speed ¾-hp. motor.

HERE'S an all-round tool that will do dozens of jobs in your home workshop. For several years the Consolidated Machinery & Supply Co., Ltd., of Los Angeles, has been manufacturing larger units for builders and furniture makers. The Comet Cub shown here is a development on a smaller scale of those industrial machines.

Its outstanding feature probably is the ¾-hp., two-speed, 110-volt universal motor. One end of the motor delivers 7,200 r.p.m. for sawing, dadoing, and to belt-drive a power

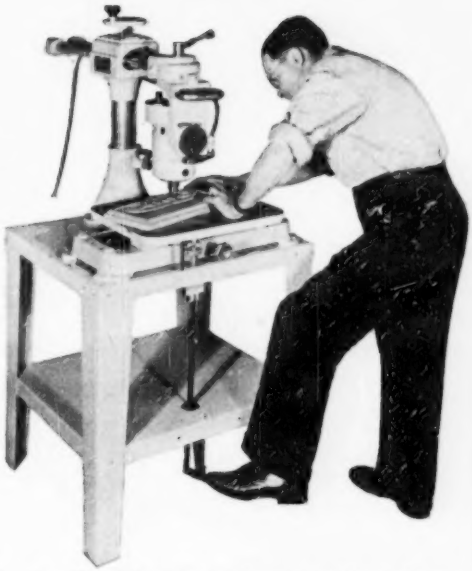


Shaping. High-speed motor, mounted on retractable radial arm, can be set at various angles so the same cutter creates different shapes.



Tenoning. Tight-fitting mortise and tenon joints for cabinet and furniture making can be cut in front or behind standard table fence.

Drilling. Straight or angled holes can be drilled in stock of any size. Table provides room for long lengths and for end boring.

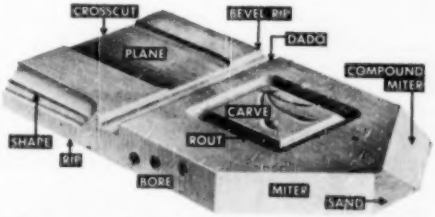


Routing. Foot-operated router table can be set for depth of cut with micrometer depth adjuster. Motor delivers 12,500 r.p.m. for this job.

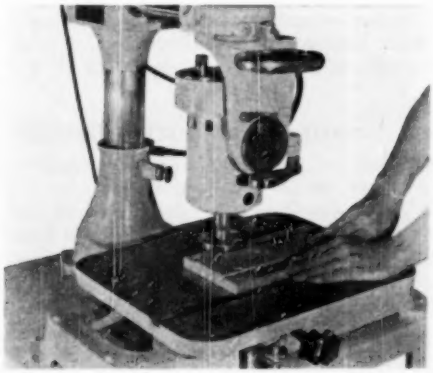
take-off. The other end turns out 12,500 r.p.m. for planing, routing, carving, shaping, drilling, mortising, and tenoning.

The power take-off—adjustable to speeds of 1,500, 2,250, and 3,000 r.p.m.—serves as the headstock of the lathe. It can also be set up for sanding, grinding, polishing, buffing, outboard turning, and for powering other tools.

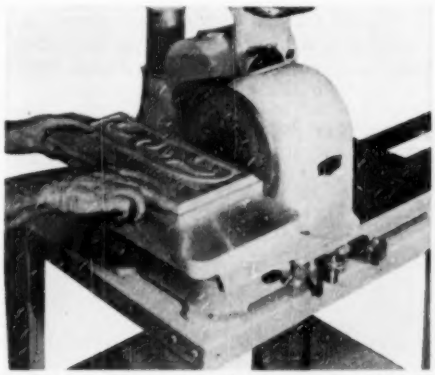
The tool is not cheap. Present plans set price on the basic unit, without all accessories, at $320. END



This block shows some things the tool can do. Grinding wheels, wire wheels, buffing wheels, and sanding drums also can be used on machine.



Planing. Tool has special planer head that can be used for surfacing stock. Variety of cutting heads makes all types of finishing possible.



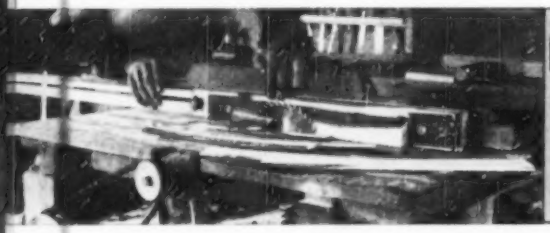
Sanding. Power take-off that serves as headstock of lathe also can be used for sanding, grinding, polishing, or to drive other tools.

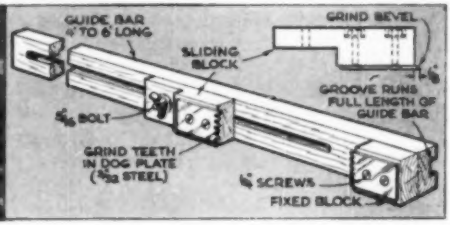
Jig Squares Table Tops and Other Glued Stock

TRIMMING the uneven ends of an edge-glued panel is an awkward job on a circular saw, but this sawing jig makes it easy. Cut a kerf about ¾" deep down the guide arm 1" from the edge. Lap the arm on the breast beam at 90°, allowing the kerf edge to project beyond the beam. Glue and screw the brace in place.

Tack the jig to the underside of the glued-up work with 6d. nails. Extend the work beyond the saw kerf, but not beyond the guide arm. Place the breast beam firmly against the work. Set the rip fence 1" from the saw blade and adjust the blade to cut ¼" through the stock. With your left arm under the work to support it, press down with your right to keep it steady on the table. With the guide arm firmly against the rip fence, make the cut. The saw blade should follow the kerf in the guide arm while you are sawing.

Special jigs can be made at angles other than 90° for evening up stock at an angle. *Charles Lincoln, Jr., Norfolk, Va.*



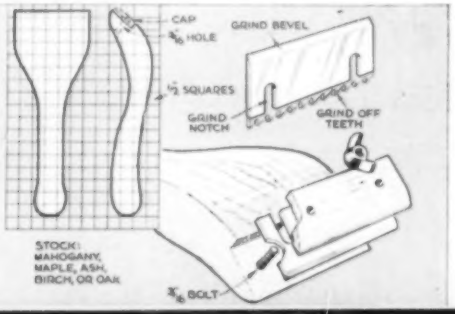


This Jig Squares Round Stock

SMALL logs and other round stock can be squared for use with this adjustable jig. To set up a job, place the jig on the bench with the fixed block against a bench stop. Put one end of the log against the fixed dog, move up the sliding block, tap it to bite the work securely, and tighten the wing nut. Before starting the saw, be sure the blade clears the dog plates.—*Roy S. MacNeill, Lillooet, B. C.*

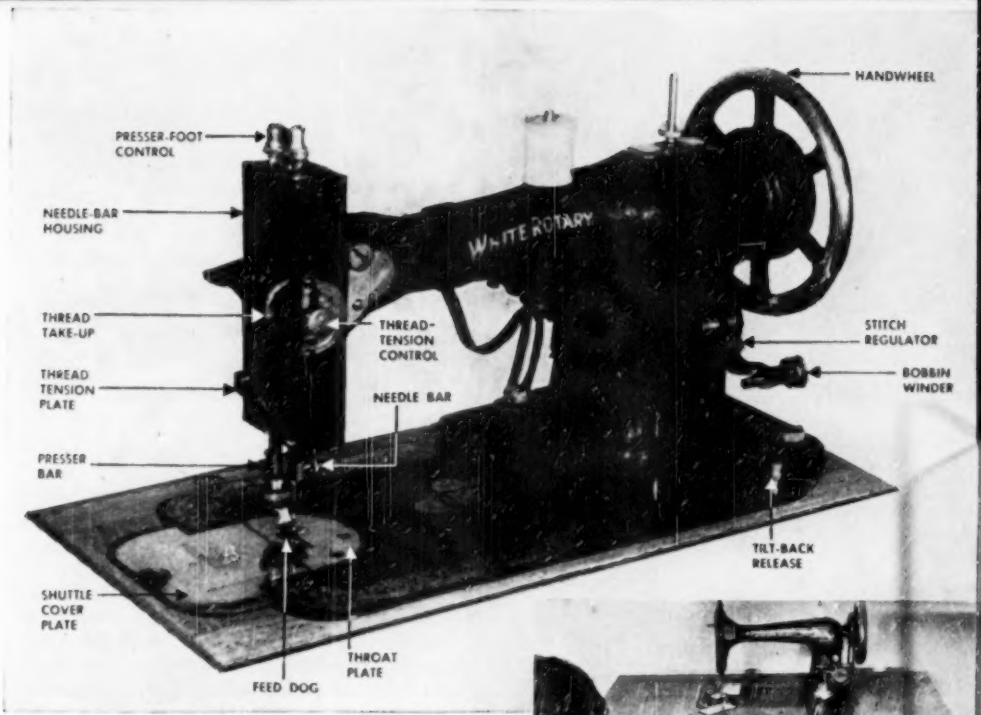
How to Make Wood Scraper from Bandsaw Blade

FOR the handle, cut a block 1¾" by 3" by 8¾" from any of the woods suggested in the drawing. Trace the side and flat views on two faces of the block. Cut the side outline first and then the other, using a bandsaw or jigsaw. Sand smooth.



You can form a blade cap from wood, but brass or other metal is better because it adds weight to the front of the scraper. File it to shape if you use metal.

Make the blade from a 3" piece of 1¼" bandsaw blade. Grind off the teeth and form two bolt slots. Bevel the opposite edge and curl the cutting blade with a smooth steel rod.—*Charles Jeglinski, New Bedford, Mass.*



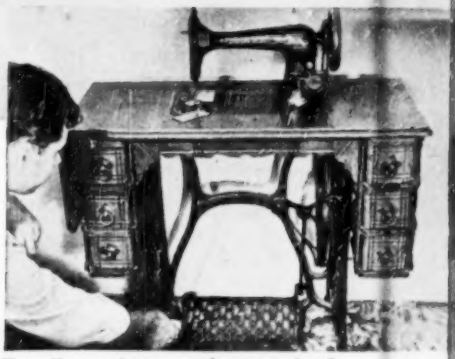
It's Fun to Fix a Sewing Machine

Even old treadle types will often respond nicely to a little oil and know-how.

By J. W. Rocke

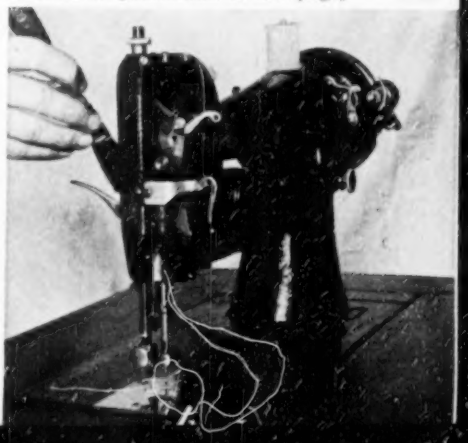
A STITCH in time—meaning lubrication and adjustment—can save you the fistful of bucks a new sewing machine would cost. When your wife mutters darkly about skipped stitches and breaking threads, a little servicing may restore her affection for the old mill. Even the newer machines often work better for a bit of attention.

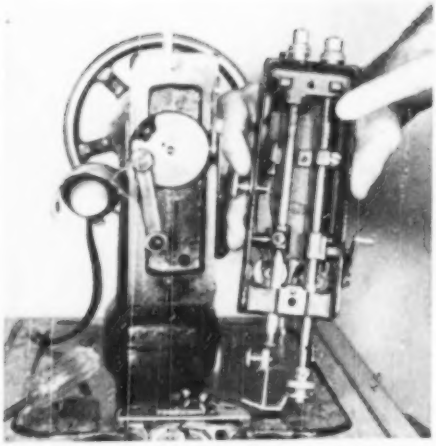
If she needs a sewing machine, you may be able to find an antique in some attic that will do fine work when it's put into shape. Plenty of old treadle machines will sew a good stitch and run easily when cleaned and re-oiled. If you want to go all the way, you can make a new cabinet for such a machine (PS, Nov. '43, p. nw 541), and even electrify it (PS, Dec. '43, p. 192, and June '45, p. 190).

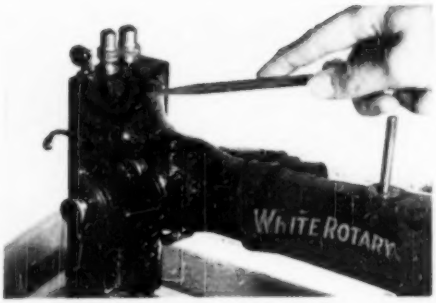


Treadle machines need not run hard. Flush out treadle pivots, pitman, and wheel bearings with solvent. Then oil. The treadle mechanism should coast easily with the belt off.

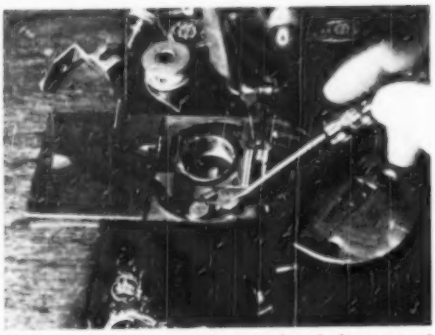
On machines that have nondetachable needle-bar housings, take off the cover plate, which is usually held by a thumbscrew. Brush out lint and dust. Then oil it. *[Continued on next page]*





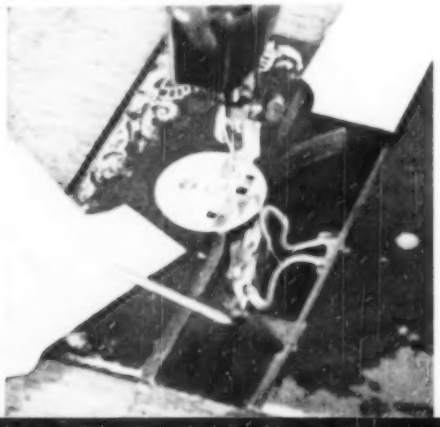


Needle-bar housing on some machines comes off as a unit (left). Remove screws on right-hand side and pull the assembly straight out from the sewing head to clean and oil parts inside. If on reassembly the needle doesn't center in the hole in the throat plate, adjust at top housing screw as above to align it.



Remove the throat plate to brush lint out of the shuttle mechanism. Hard running may be due to nothing more than bits of thread wound around the shuttle, particularly in rotary types like this. Pick them out with tweezers. Flush out with solvent, and oil. Screwdriver points to felt wick that lubricates the shuttle race in this machine.

Long shuttles are lubricated by an oil well under the front slide plate. Clean it and the passage from it to the shuttle race. Repack the well with wool yarn, fill it with oil, and make certain the oil feeds through.



You needn't know a hemstitch from a ruffle to fix a sewing machine, nor have any tools beyond a screwdriver, small pliers, and a pair of tweezers.

Cleaning and oiling. Complaints about hard running are often due to gummed, dirty working surfaces. Most machines are built so that the heads can be tilted back, exposing the works for oiling. Do this, fill an oil can with kerosene or commercial cleaning fluid, and squirt a little into all moving parts to flush them out. Run the machine a little, with the presser foot up. If it doesn't run freely, continue flushing.

Let the solvent drain off, wipe external parts dry, and oil generously. Run the machine again to distribute the oil. Then wipe off excess oil. Dry surfaces are less likely to collect dust and lint.

Oil the machine sparingly about once a month, or more often if it's used much.

Check the needle. Many sewing troubles can be traced to the needle. Is it the one recommended for the machine? The handbook will tell you, but if that's missing and you're in doubt, you can look up a chart in a store that sells sewing-machine needles.

A bent needle will skip stitches. Roll the needle between two fingers. If the point swings in a circle, get a new one.

To determine whether a needle is the right length, watch the shuttle hook as it crosses the needle. The hook should enter the thread loop when the latter is widest. A short needle won't form a loop big enough for the hook to enter.

If the needle doesn't pass close to the hook, it may be bent or improperly inserted.

Always put it in with the flat side of the shank facing the clamp screw, and the eye groove toward the shuttle hook. Be sure it's all the way up in the needle socket.

A dull needle will pucker the seam. If necessary you can sharpen it on crocus cloth, but a new needle is better.

Shuttle ailments. Bits of thread tightly wound around the shuttle mechanism can make the best machine run hard. Pick them out and make sure the race in which the shuttle turns or oscillates is lubricated. A blunted shuttle hook may not pick up the thread loop. In long-shuttle machines, the cradle in which the shuttle rests may hold it too tightly. Since the thread loop must pass over the point, there must be clearance between shuttle and cradle. But the shuttle must also be held close to its race—the curved edge against which it slides.

Wrong shuttle threading, too full a bobbin, or a broken shuttle-tension spring are other points to check.

Material feed. The teeth working in slots under the presser foot feed cloth through the machine and space the stitches. The machine should never be run with the presser foot down unless there is material under it. If the teeth are allowed to run against the presser foot, they soon dull.

When the material won't feed through, make sure the stitch-length regulator isn't set too fine (or at zero feed) and that there is enough pressure on the presser foot. Watch the feed dog in action with the presser foot up. Do the teeth rise above the throat plate as they should? If not, adjust the feed dog.

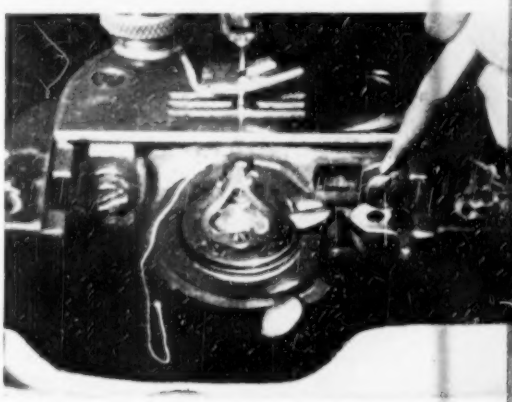
Perhaps the teeth are so dull they don't get a bite on the cloth (some materials are more slippery than others). If the machine is so old you can't buy a new feed dog, it may pay to try to sharpen the teeth. Better remove the dog. Joint the teeth level by rubbing them across a fine oilstone. Then use a thin slipstone to sharpen the notches.

Do threads break? A leading cause of this trouble is that the machine just isn't threaded right—especially likely if it came from Aunt Mary, who got it from Aunt Lucy, who in turn got it from her mother. Beg, borrow, or steal a handbook if necessary, or ask somebody who would know.

Upper thread tension—the drag at the needle end of the thread coming off the top spool—should be readily felt, but not be so great as to break the thread.

Slipping drive. A gummed or dirty

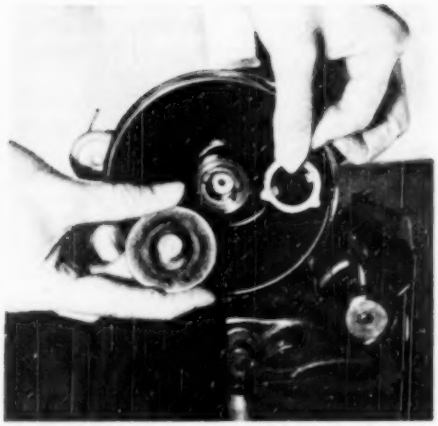
Pressure of presser foot on the material sewn is adjusted by this knurled cap. Too little may cause staggered or uneven stitches. Too much makes the machine run harder.



Toothed feed dog under presser foot should rise until bottoms of tooth notches are just even with throat plate. If too low, they won't feed material through; if too high, material will pucker. In this machine, lock screw (indicated by pencil) is loosened, dog set, and the screw retightened. Methods of adjustment vary, but tooth setting is similar in all.

Thread take-up, of whatever type, should maintain tension on thread until needle enters the cloth. If it doesn't release then, or doesn't snap back to its stop, loosen its clamp (a split bolt in this case) and rotate or bend the spring to increase or decrease its pull.

Loose threads on underside of a seam indicate top thread tension is too loose. It's adjusted by knurled nut as shown. Loose loops on top of a seam, although rare, call for tightening shuttle thread tension, usually by turning a screw that goes through the shuttle spring (see insert above). This should put a drag on the thread. Tension on top and bottom threads should be about the same.



For smooth release of the handwheel clutch, take out the small stop screw and back off the lock nut. Remove friction washer, clean all parts, and replace. If turning lock nut backward doesn't release clutch, disassemble again and rotate friction washer half a turn. Oil with lock nut in loose position.

mechanism should be cleaned first. Clean out the belt grooves on a treadle machine and make sure they're not oily. If they are, wipe the belt as well as the grooves with solvent.

Belts stretch with time. A loose one can usually be cut a trifle short and rejoined. Use the standard piano-wire link rather than makeshifts, and open it by twisting the two ends sideways, not outward. If you haven't a punch or drill of the right size for making a hole in the belt, you can burn it with a red-hot nail.

The belt should be just tight enough not to slip. Overly tight belts make the machine harder to treadle.

Electric drives are by friction or a short spring belt. If they slip, clean off any oil film. Check the spring action that holds a friction drive in contact. END

SEWING-MACHINE CHECKS

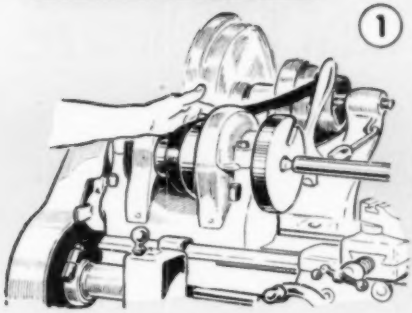
COMMON TROUBLES	POSSIBLE CAUSES
Material does not feed through properly	Bent feed dog or presser foot. Feed dog out of adjustment. Incorrect presser-foot pressure. Dirt in feed-dog mechanism. Stitch-length regulator not working or at extreme setting.
Stitches are of uneven length	Feed dog improperly adjusted. Dirt or gummed oil in feed-dog mechanism. Insufficient pressure on presser foot.
Side puckers occur along seam	Dull needle.
Lower thread breaks	Lower tension too tight. Sharp edges on needle plate. Bobbin wound unevenly or too full. Rough edge on lower tension spring. Dirt in shuttle (bobbin cannot turn freely). Bobbin or shuttle incorrectly threaded.
Upper thread breaks	Machine incorrectly threaded. Needle groove wrong side out. Needle bent or rubbing some part. Thread too fine for needle. Needle eye rough or sharp. Upper tension too tight. Insufficient clearance between shuttle and cradle (in long-shuttle machines).
Machine skips stitches	Needle bent. Needle too small for thread. Shuttle point blunt or worn. Needle of incorrect length. Needle set wrong side out. Needle incorrectly threaded.
Cloth puckers along seam	Thread tensions too tight.
Stitches are staggered	Take-up spring not releasing soon enough. Insufficient pressure on presser foot. Take-up spring weak or missing.

FOR YOUR POPULAR SCIENCE INFORMATION FILE

WHAT'S WRONG ?

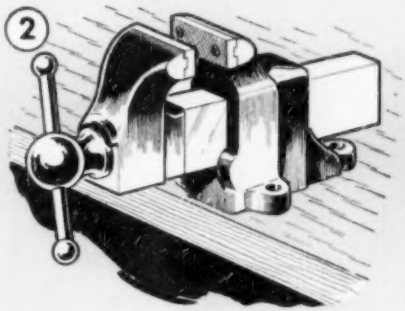
There are six hazards hidden in these drawings of common tool setups and uses.

1



Deft fingers can shift a flat belt on the pulley steps this way without stopping the motor and countershaft.

2

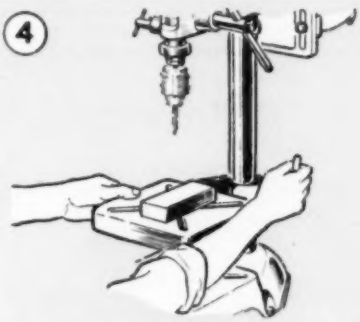


A good, heavy vise stays put by itself on a bench top, and remains portable for use elsewhere. So why bolt it down?

3

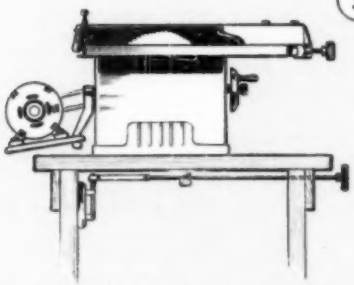
Gasoline will take tar spots off chrome, and an electric drill with a buffer in it gives a quick polish on the car body.

4



You can raise the table even with the motor running. This saves time, and also spares the motor an extra start.

5

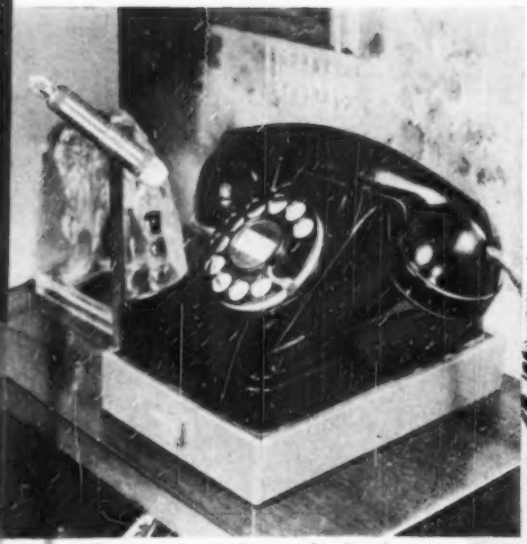


A pad below the bench edge controls the emergency knife switch. The motor has an automatic-reset overload cutout.

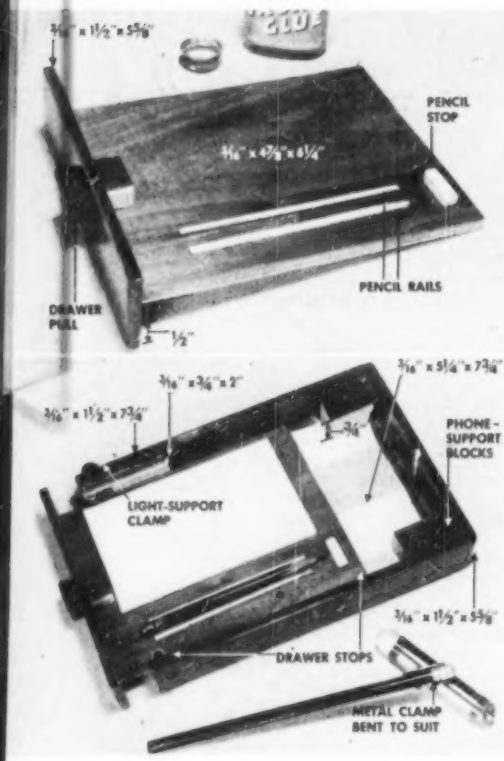
Answers

1. Even when the experts do this, they risk being pinched between belt and pulley. Use a stick, or better still, stop the motor.
2. Some day when the vise is opened wide, the movable jaw will overbalance the body and tip the vise onto somebody's toes.
3. There's enough sparking at drill-motor brushes to ignite gasoline vapor.
4. The table may resist and then go up all of a sudden, banging your hand or arm against the revolving drill. Turn it off.
5. The knife switch should be mounted to open at a push, not a pull, for quick emergency action. Never use a motor with an automatic-reset overload switch on a saw. If it opens and you forget to cut the main switch, it may start up again when you're touching the blade.

Lighted Phone Pad Helps Take Messages



Paper and pencil are under the phone, easy to reach, but never in the way.



YOU won't have to tell callers, "Wait till I find a pencil," if your phone is on an illuminated pad like this. It's designed to bring order out of the usual jumble of telephone jottings, and is especially handy at night because it has a built-in light that can be beamed at either the note pad or the dial.

The base takes up no extra space on the table and adds only about 1½" to the height of your phone. Four ¾"-high corner posts inside the base support the instrument. Details given in the photos at the left are for the new-style, rectangular-base combination phones.

To make the unit skidproof, you can cement rubber or felt feet to the bottom. Finish it with a coat of enamel to match the phone table or the phone itself and it will be a decorative addition to your desk.

If you have a lamp near your phone, you may not want to bother with the dial illuminator, but it will prove a great convenience if your phone is in a dark corner. Using a one-cell flashlight makes it independent of house wiring and outlets.

To make the lamp holder, fasten an unsharpened pencil to the side of the base with cable clamps. Bend a thin strap around the flashlight and screw the strap to the top of the unsharpened pencil or dowel.—*Arthur C. Miller, North Bergen, N. J.*

Soft Water Saves Money

Billowing suds, as above, or a flat, scummy solution, as at right—the water's hardness accounts for the difference. The soft-water suds look better, clean better, and cost less.

Hardness robs you of fuel, soap, and clothes. Chemicals will eliminate it.

By Martin Mann

THE old-fashioned water barrel wasn't beautiful, and it sure bred mosquitoes—but it did supply good, soft water. Nowadays hard water makes the money flow in all too many parts of the United States. But chemicals can remove the fuel-wasting, soap-squandering, clothes-harming minerals from the water in your home.

Heaven's rain is soft, but it seeps through miles of earth before it gets to your tap and—unless you live in the East or near the Northwestern coast—this may harden it.

This hardness leaves a hard scale—like limestone—in the pipes and tubes of hot-water heaters. The scale insulates the heater tubes and extra fuel is needed to warm the water.

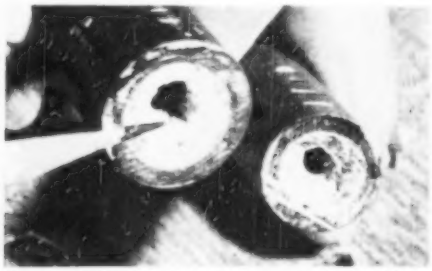
That's only one of the ways that hard water makes trouble. Hard water spoils $50 to $100 worth of soap a year for an average family. The minerals in it react with soap to form a gray scum—you've seen it as the ring around the bathtub. Not until all the minerals have been removed by this wasted soap can the rest of the soap lather and wash things clean.

Hard water makes clothes difficult to

How hard is your water? Put a pint of cold water in a clean quart Mason jar. Add Lux soap flakes by level quarter-teaspoons (left) until you get firm white suds by shaking jar full minute *after each measure*. Suds with one measure means soft water; with two measures, water is three grains hard; with three measures, six grains hard; with four measures, nine grains; and so on. Permutit Co. developed this rough home test especially for POPULAR SCIENCE.

clean. And they wear out faster. The soap-mineral scum gets into cloth fibers and won't rinse out. This leaves white things gray. And it wears the fibers away. It makes the womenfolks' hair dull, even right after a shampoo. It dulls porcelain and chrome fixtures, even though they're clean. It loads up the teakettle with scale. And it affects the flavor of some cooked foods.

Minerals picked up as the water seeped through the earth are responsible for all this. They are usually calcium bicarbonate ($Ca(HCO_3)_2$) and magnesium bicarbonate ($Mg(HCO_3)_2$). A gallon of moderately hard water has only about seven grains (.016 ounces) of dissolved minerals in it—but that's enough to make trouble. Like other culprits, however, these sly pickpockets can be foiled in many ways.



Unseen waste of fuel—and money—results from scale like limestone that hard water deposits in heater coils and pipes. Pair above, cut open by Culligan Zeolite Co., are nearly clogged.

Soap wastage and scum can be eliminated by adding chemicals—borax, complex phosphates, or plain old washing soda—to the laundry water. Or you can use synthetic detergents instead of soap for clothes, dishes, and hair shampoos.

These methods, however, solve only part of your troubles. Laundry softeners don't work too well in automatic washing machines. The detergents, which usually cost more than soap, aren't quite as good as soap at cleaning cottons. Bar detergents, for bath use, are not yet generally available. And none of these things can keep scale out of hot-water pipes and teakettles.

The real solution is a softening unit connected to your water main, to take hard-water minerals out of the incoming water.

A home softener looks like a hot-water tank. It consists of a tank, filled with a special chemical, plus some piping and valves. The chemical, called an ion-exchange material, is sold under many trade names, but is one of two types of compounds. Usually, it's *zeolite*, a synthetic duplicate of a natural mineral. But newer softeners use *synthetic resins* that have no natural counterparts, and soften more water with less material; hence the tanks can be made considerably smaller.

Ion-exchange chemicals swap atoms with

other chemicals. Those in the softeners trade atoms of sodium for the calcium and magnesium atoms in hard water. Thus water enters the softener containing calcium and magnesium bicarbonates—the hard-water troublemakers—and leaves containing sodium bicarbonate, which is harmless.

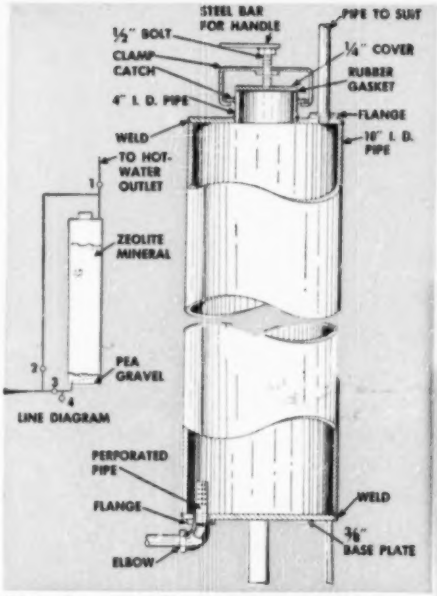
When the ion-exchanger's sodium is traded away, the exchanger won't soften any more water. It must be regenerated. This is done by running plain salt solution (sodium chloride) through the exchanger. The exchanger trades its calcium and magnesium atoms back for fresh sodium atoms. (During regeneration the valves are switched to send the unit's output—calcium and magnesium chloride—down the drain and not into your water pipes).

You Can Rent Softener Service, Too

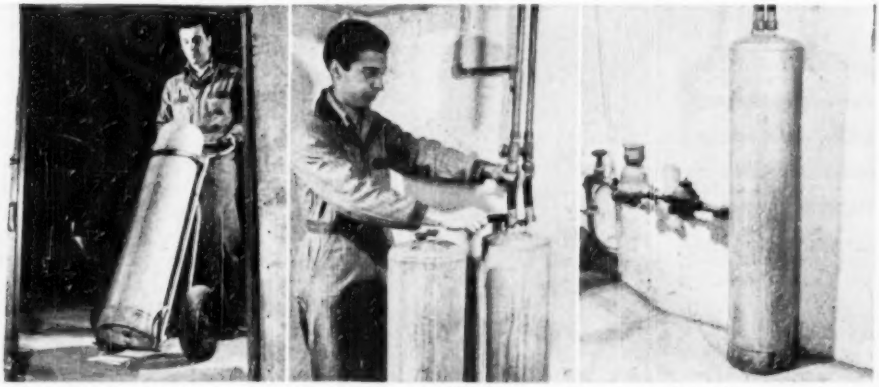
Home water softeners range from small ones with manually operated valves, costing about $100, to de luxe models that take care of regeneration automatically with meters or time clocks and electric valves. These cost upwards of $200. In hard-water areas, however, you can often arrange for a softening service similar to a diaper service. For a few dollars a month, a serviceman will bring you a fresh exchanger unit and take the old one to his plant to be regenerated there.

Water hardness varies a lot, even between neighboring wells. The local water department will tell you how hard your city water is. And if you have your own water supply, the softener companies are always ready to analyze a sample for you.

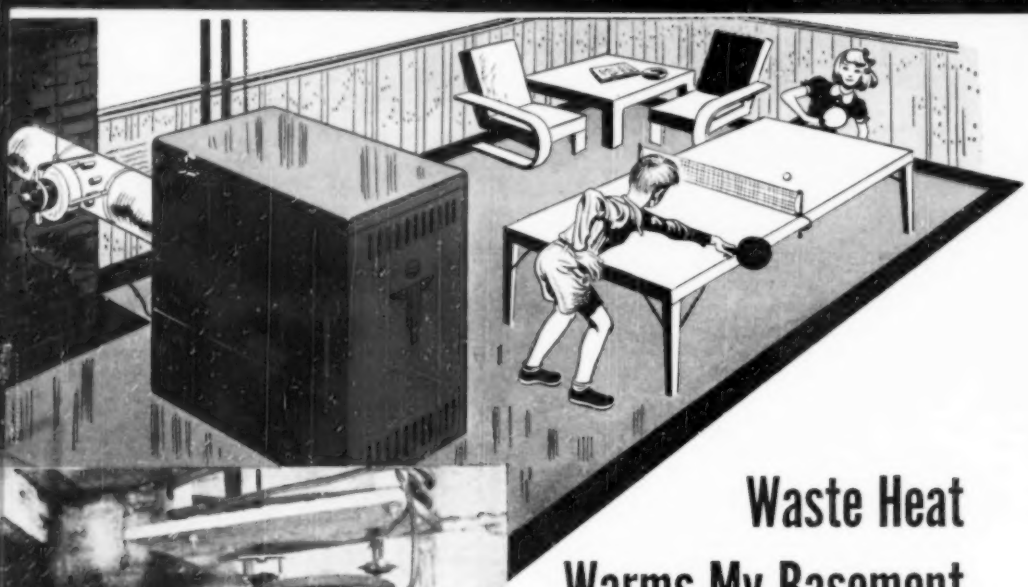
If the hardness is seven grains per gallon (sometimes reported as 120 parts per million), a softener will probably save you money. If it's 10 grains (171 parts per million) or more, there's not much question about it. END



If you're a good amateur plumber, you can build your own softening unit. Sketch above shows details of one made by John Kubilis, of Batavia, Ill. It has top opening for salt that regenerates chemical filling. Line diagram shows valve arrangement: 1 and 4 are opened for softening; 2 and 3, for regeneration. Softening capacity you need determines unit's size.



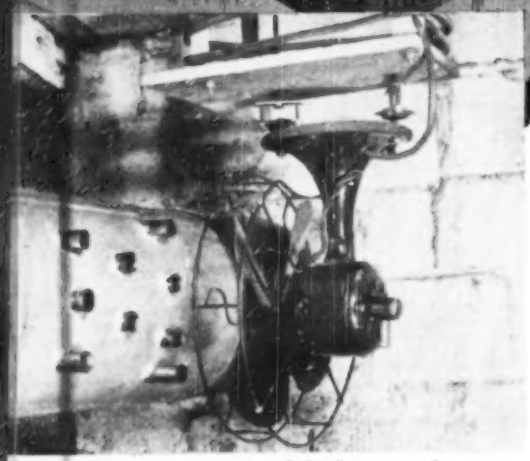
Many towns have softener rental service. Here route man for Gusmer & Martin, New Jersey firm, brings fresh unit (left), loosens quick-disconnect fittings on old tank (center), and leaves fresh one hooked into water line (right). Old one goes back to plant for regeneration there.



Waste Heat Warms My Basement

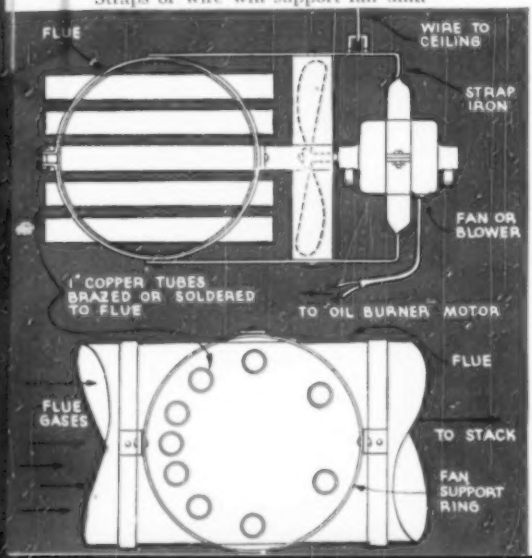
With a fan and a few pieces of copper tubing, you can reclaim some of the heat lost up the chimney.

By Herbert F. Bariffi



Shock mounts suspend the fan mount from overhead platform so vibration won't get to joists. Tubing-to-pipe joints must be made gastight.

A more shipshape installation could be made like this, perhaps with exhaust fan or blower. Straps or wire will support fan unit.



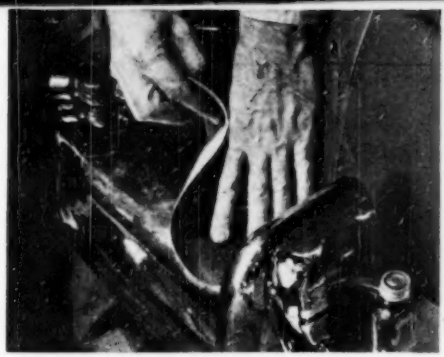
EVERY furnace loses heat up the chimney. For nine years now, I have been tapping this waste to warm my basement and keep down my fuel bills.

There's no trick to it. A simple heat exchanger is located in the flue pipe behind the oil burner. An ordinary fan drives air through the exchanger and circulates it in the basement. The fan turns on and off, automatically, when the oil burner does.

The heat exchanger consists of a length of stove pipe with nine pieces of copper tubing placed crosswise through it. Flue gases heat up the pieces of tubing. The tubes, in turn, heat the air that the fan forces through them.

Cut the tubes about an inch longer than the flue-pipe diameter. Stagger them in elevation so as to present the maximum surface to the flue gases. It's best to arrange the tubes near the outer edge of the circle described by the fan blades. This takes advantage of the higher air velocity away from the center of the blades. Hard-solder or braze the tubes in the pipe and make sure the joints are airtight.

Any good fan about 10" in diameter can be used. Connect the fan leads directly to the oil-burner motor terminals. Be sure to oil the fan motor at least twice a year.



Step Pad on Car Bumper Hides Scratched Chrome

WHILE a car is parked, a broad-topped bumper offers such a handy place for idlers or passersby to rest their feet that the chrome often becomes scuffed, leading to rusting.

To prevent this, or cover damage already done, you can cement on a decorative step pad cut from vinyl upholstering material or thin rubber. Clean the surface of the bumper and apply Pliobond cement to it and the back of the pad. Press the pad into place, being careful to get perfect adhesion along the edges and to smooth out blisters that might trap moisture.

Plastic Tape "Welds" Quickly

LAYERS of a new insulating and splicing tape derived from Bakelite polyethylene resins weld into a continuous elastic skin within a few minutes. Once wrapped around pliers as shown, the tape would have to be cut for removal. Made by the Bishop Manufacturing Corporation, New York, the tape has no adhesive, but it sticks to itself when stretched and wrapped in the regular way.

They're air-line employees. The speaker is referring to a flight schedule that allows more time than is actually needed to make the trip.

Tiny Photoflood Packs Punch

REFLECTOR flood lamps for home photography are getting smaller—as this picture shows. The small, mushroom-shaped bulb is a new 300-watter recently put on the market by Westinghouse for about $1.25. Contrasted with it is one of the old size.

The small one has a diameter of 3¼". It fits a standard socket, has a life of about four hours, and a beam spread of 40°. Westinghouse engineers claim that up to five of the new lamps can be placed on the usual 15-ampere home circuit.

Making Small Sanding Disks

FOR occasional use on a grinding head or motor arbor, you can make small sanding disks by cutting circles from heavy aluminum oxide cloth. Cement the circles together back to back and clamp between boards to dry.

Cut a similar circle from linoleum to serve as a pad. These assemblies can be mounted on a threaded shaft with a flange nut. Mount them against the side of a grinding wheel, a soft buffing wheel, or a plywood disk.—*Paul Woodruff, Chicago.*

1 Belt is cut from a hide of leather with a draw gauge. This tool maintains proper width the full length and leaves a clean edge.

2 Skiving knife tapers end of belt for the buckle. Narrowed width has been scribed beforehand with hermaphrodite calipers.

Leather Tooling as an Expert Does It

HUNTING for a hobby? Leather work is one of the simplest and most satisfying. It may be what you're looking for.

You don't need expensive equipment or much working space. On a kitchen table or a desk in your den, you can turn out distinctive projects with the mark of real craftsmanship on them. Such a variety of things, and so many different treatments, are possible that you need rarely repeat yourself.

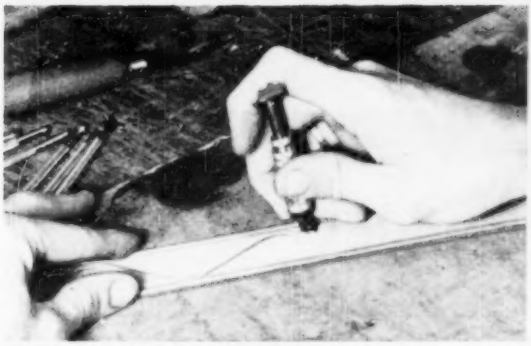
Handmade leather goods are always appreciated as gifts. And if you want to make your hobby pay its way, you may find a market for your work.

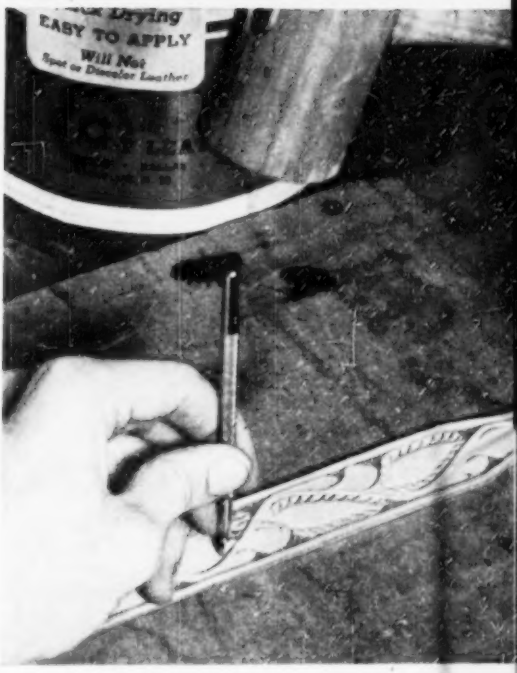
That's what James Redford, a Fort Worth veteran, did. After getting the hang of the craft, he began to sell his handiwork. Today it keeps him busy full time in his home.

If you want to see the steps in making a typical project, look over Redford's shoulders in these photos as he turns out a hand-tooled leather belt. The result is a quality article in which Redford—or you—could well take pride.

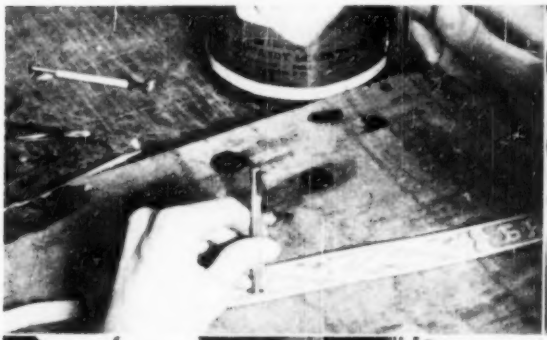
3 In preparation for hand tooling, the flesh side first, and then the other, is dampened with a sponge until the leather's color darkens evenly.

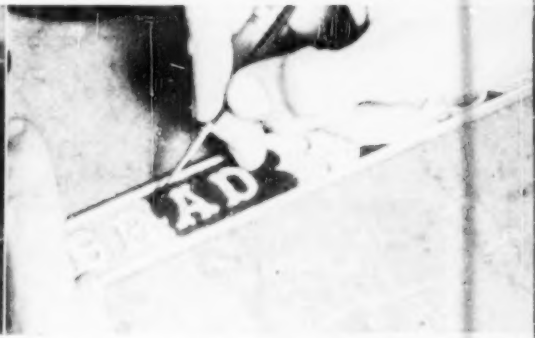
4 Tooled border is worked with a saddler's scratch compass, which automatically maintains uniform margin. Note leather shavings.





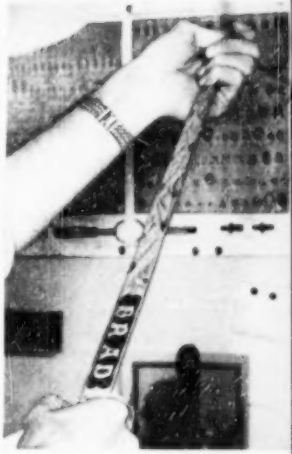
5 Freehand tooling is begun with a swivel knife. All tooling must be done on a very hard surface (in this case a marble slab). After lines of design have been worked in, a background tool is tapped with a mallet to add stippled texture in certain areas (at left). Then a veiner is held at an angle and tapped to form fringe design as at the right.

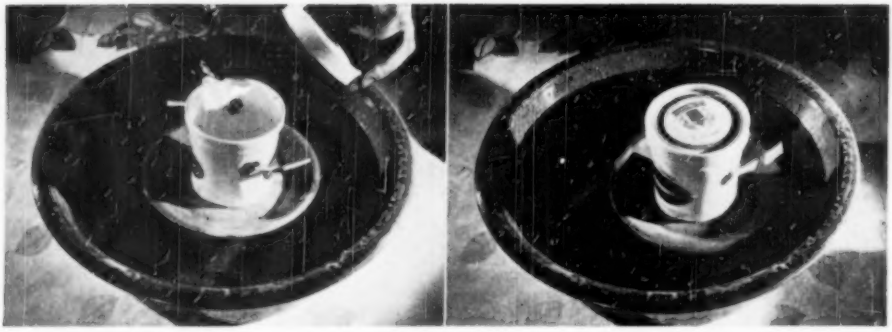




6 Flat-ended burnishing tool shades leaves in depth and, by compressing leather, turns them a rich tan (left above). Tooled name is done with swivel knife and background tools. For contrast, background is toned with leather dye (right above). Belt is next treated all over with a good leather finisher to waterproof it and add luster, as at left.

7 Finally, the edge of the belt is rubbed with heavy duck, as shown at right. This gives it a high polish, completing the project.





How to Make a Jet Engine in Your Living Room

With the help of a few small chunks of dry ice—usually obtainable from ice-cream manufacturers or dealers—you can quickly make a fascinating jet-propelled turbine, and make tableware and cooking utensils "sing." But:

- Because solid carbon dioxide (dry ice) is so extremely cold, it should never be handled with the bare hands—use a cloth or tongs.
- Because its vapor pressure at room temperature is tremendous, never try to confine it in a completely sealed can or bottle.

All you need for the turbine is a cardboard ice-cream or coffee container, a drinking straw, some sealing wax, and a small pie plate. Punch two small holes in the container, on opposite sides, and fasten in each hole a 3-inch length of the straw with the sealing wax—curving the straws as shown above.

To operate, put about half an inch of tepid water in the container, float the container on the pie plate in a basin of water, drop in a piece of dry ice, and put on the cover. Heat from the water causes the dry ice to evaporate rapidly. Vapor streaming from the straws reacts backwards against them, causing your turbine to spin.

To make metal forks, knives, or pots sing loudly, just rub a piece of dry ice lightly along the edge of one of these objects. Why? Because the intense cold of the solid carbon dioxide causes a rapid contraction and expansion of the metal.

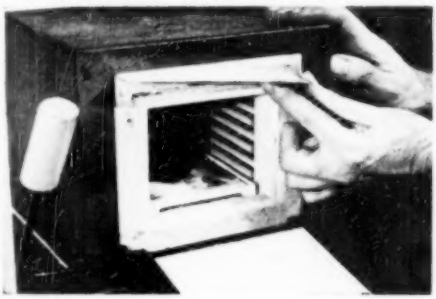
Plastic Cover Shields Flash

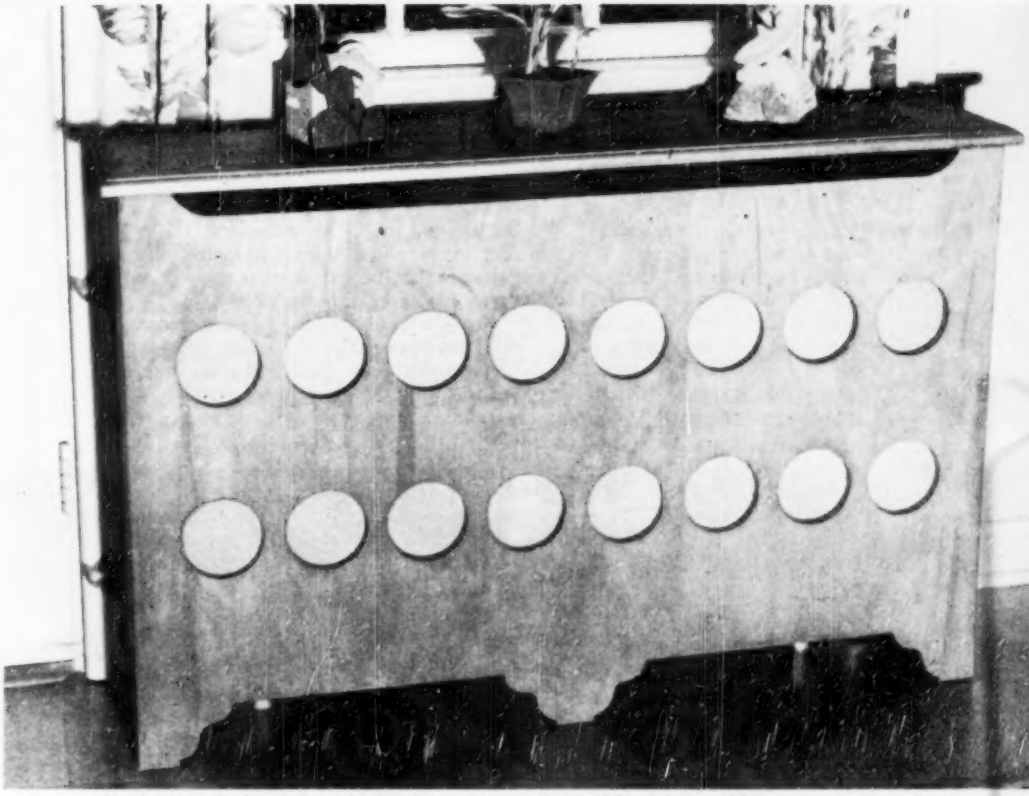
One side of a new plastic cover for Eastman Kodak flash units is clear, the other matte. By shooting through the clear side you get normal flash lighting. The diffused side softens the light. The 2-Way Flashguard sells for 55 cents.

Heat Deflector for Kiln Keeps Housing Cooler

When heat from the opening of a small kiln seems to overheat the metal jacket, a strip of metal placed as shown will deflect the heat. Cut the strip from a tin can and bend it L-shaped so one edge can be pushed beneath the jacket. Fold the other edge double and round the corners.

A projection of an inch may be sufficient, but if the strip is wide enough it can be used as a shelf for preheating and drying work to be placed in the kiln.—*Walter E. Burton, Akron, Ohio.*





Enclosure of plywood, with circular openings, backed by fabric, adds to appearance of room.

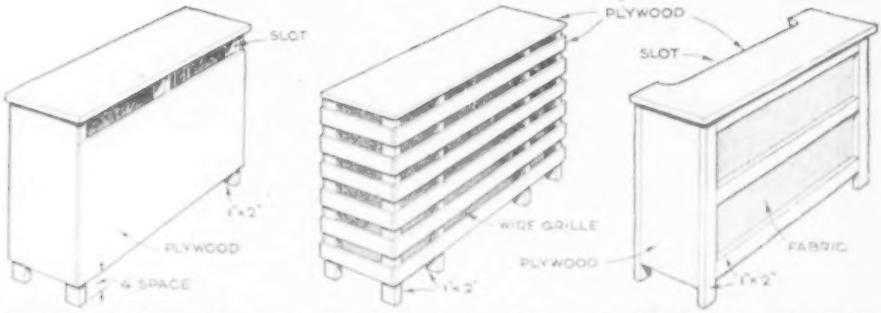
How to Hide Radiators

Covers are both decorative and efficient —when they're made right.

By Robert Scharff

CONSPICUOUS and unsightly radiators can be made to harmonize with modern interiors and furnishings. But a radiator can't be covered just any old way. A poorly designed enclosure can reduce heating effectiveness as much as 50 percent.

You can, of course, buy radiator covers. With a little ingenuity, however, you can design and make your own to fit in with the other furnishings in your home. But before designing your enclosures, you should learn



In suggested designs above, openings in front can be covered with fabric or wire grille.

how a radiator works. Then you'll be able to build your covers to get the best heating results.

A radiator supplies heat to a room in two ways:

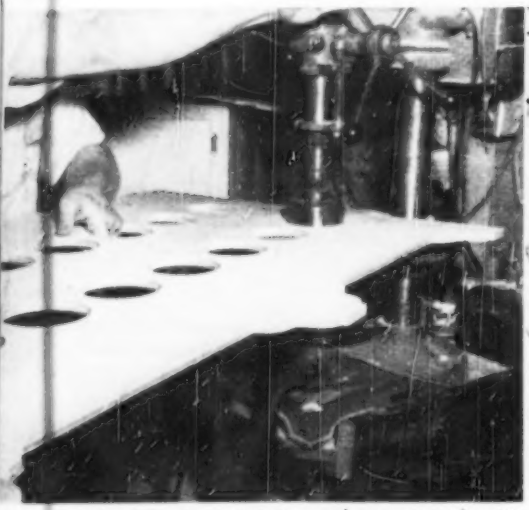
- By radiating heat waves (radiation),
- And by heating the air (convection).

Radiant heat can be compared to the sun's rays. It consists of direct heat waves that strike the surfaces and objects in a room. When these heat rays strike a cooler surface, some of them are absorbed and the rest reflected. The absorbed rays warm the surface and the surface then reradiates its own rays.

The comforting warmth you feel from these radiant rays is supplemented by heated air, or convection. As cool air moves upward between the radiator sections, it becomes heated. Heated air first rises toward the ceiling. It's not until the air in the upper part of the room nears the heated-air temperature that the air starts coming down to do its job of heating the room.

Both of these sources of heat finally meet and blend together. So when designing a radiator enclosure, both radiation and convection must be considered.

In designing your radiator covers, don't



Front openings of cover are being cut with a 4" circle cutter (above). Jigsaw is slower, but it could also be used for this operation.

Assembling the enclosure. Nails or screws may be used. If you plan a natural finish, set the heads and cover them with composition wood.

Shut-off valve should be accessible through a hinged door such as that shown below. Snap catch on top of door will hold it closed.

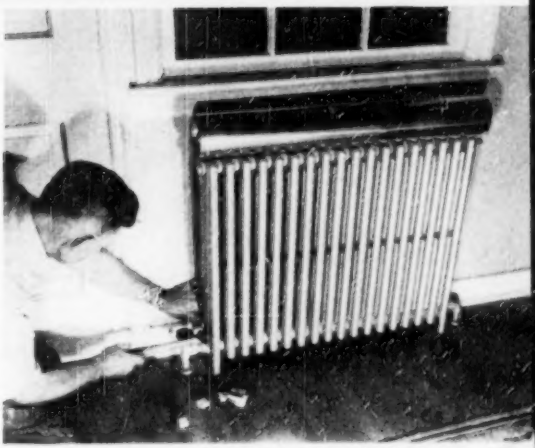
Cut out rear of enclosure at the bottom so that it will fit over baseboard. Otherwise, back of cover will not fit snugly against the wall.

box in too much of the heating surface. Leave openings—they'll be disguised with a wire grille or loosely woven fabric—so the heat can get out. Plan an opening along part of the top, at the rear, to allow hot air to escape. Or better still, make a reflector back for the radiator out of light-gauge aluminum. Curve the reflector over the top of the radiator. The reflector will not only cut down heat loss into the wall, but will throw the heat forward and out. Then you can do without the slot at the rear of the top.

Instead of sheet aluminum, you can use heavy cardboard and aluminum foil—the kind sold in houseware stores. Glue the foil to the cardboard and then curve the cardboard over the top of the radiator. Don't let the reflector touch the radiator and keep the reflector at least ½" from the wall. Use spacer blocks between the reflector and wall.

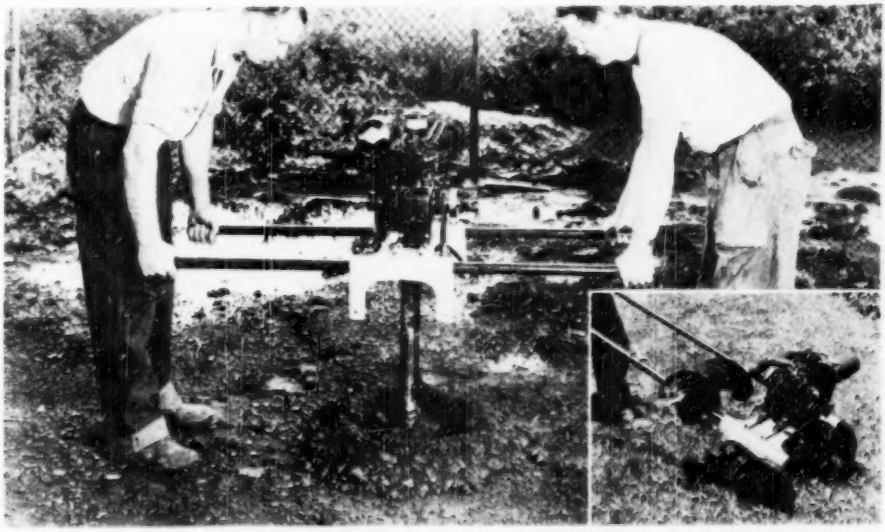
If you want to use the top of a cover as an extra shelf for knickknacks, books, or house plants, it's generally best to insulate it. Glue and tack sheet asbestos to the underside of the top. This will prevent the top from becoming overheated.

The finish of the radiator itself also affects its heating efficiency. Metallic paints—like bronze or aluminum—cut down heat radiation. Such paints tend to reflect part of the heat back into the radiator instead of allowing the heat to radiate out into the room. Oil-base paints are better for radiators. A coat or two of oil paint may increase the heat-radiation of a radiator by as much as 15 percent. END

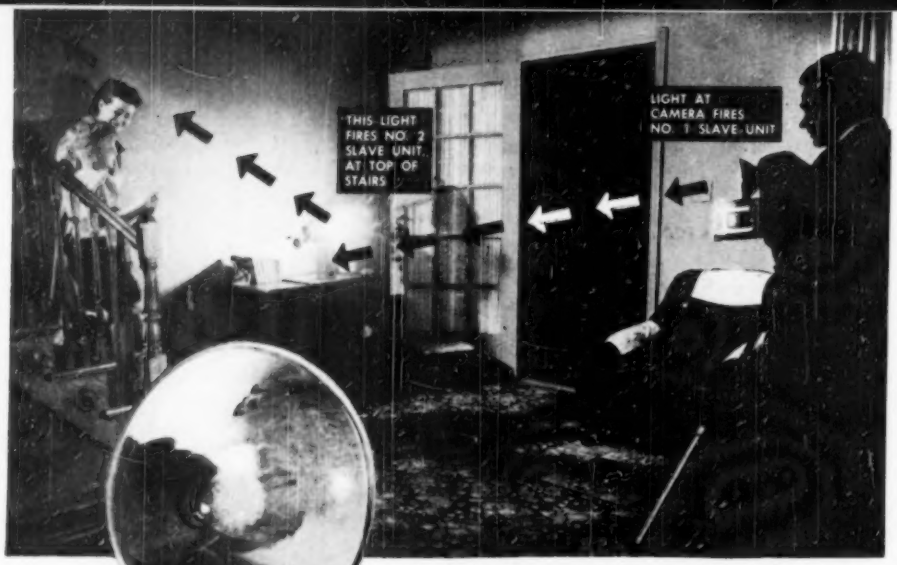


Wood blocks are bradded to wall and sheet aluminum tacked to blocks. Reflector, curved over top of radiator, throws heat forward.

Portable Power Unit Digs Postholes in a Hurry



Two men can dig a 9" posthole 3' deep in a matter of seconds with this gasoline-engine earth borer. The motor frame is an aluminum-alloy casting. Total weight of the tool is less than 100 lb. A centrifugal clutch controls operation of the auger. Wheels can be mounted quickly for moving the machine to a new location. The Choremaster Division of The Lodge & Shipley Company, Cincinnati, prices the digger at about $135.



One light fires another. Two slave flash units were used above, one near the subjects and a second up the stairs, out of sight of the master flash at camera.

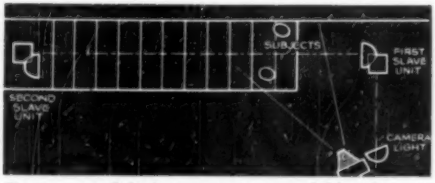
Chain Reaction Lights Photos

PS photos by W. W. Morris

Here's the photo taken above. Two slaves fire about four microseconds apart. A shutter speed of 1/100 sec. catches peak of both flashes.

PHOTOGRAPHERS know the outfit at the left as a "slave" flash unit. A master flash at the camera sets it off without cumbersome connecting wires. A photoelectric cell triggers the slave.

Such units have been available for several years, but this new one, made by Alcah, Inc., Pawtucket, R. I., is said to lick several operating difficulties. It has no switch, so there is no chance of forgetfully draining its 300-volt B battery that fires the flash bulb and operates the photo cell. The unit responds to *changes* in light intensity only, and is always near peak sensitivity. No adjustment is necessary for specific lighting conditions. The device synchronizes at 1/100 sec. with any of three common bulbs —No. 5, No. 11, or No. 22.

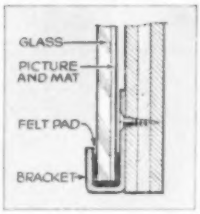


Camera and lights were arranged like this. A No. 22 bulb was used at the top of the stairs, and No. 5s at camera and in first slave unit.

Fire Saves Photo Developer

To lessen oxidation in a partially emptied bottle of developing solution, fix a small swab of cotton on the end of a wire, moisten it with alcohol, light it, and lower it into the bottle. It will go out as soon as the oxygen is exhausted. Cork the bottle quickly.—*John M. Overstreet, Birkenfeld, Germany.*

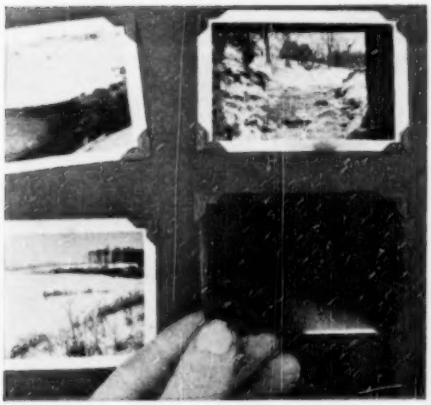
Brackets Support Pictures



Unframed prints, photos, etchings, and the like can be hung on paneled walls in a pleasing manner with three or four brackets bent from ½″ by 1¾″ strips of 1/16″ brass or other metal. Cut a sheet of glass the exact size of the picture mat. In bending the brackets, make the bottom of the U equal to the combined thickness of the mat, glass, and a small felt pad. Drill and countersink a screw hole in the long arm of the bracket. After screwing the brackets to the wall, slide in the glass and picture.—*Eric St. Clair, Richmond, Calif.*

Wet Photos Can Be Folded

Folded greeting cards can be made from single-weight photographic paper. When taking a print from the wash water, fold and crease it at the desired place. Then open the fold. After the print is dry, you can get a neat fold again because the wet creasing has broken down the fibers.—*Willard Allphin, Danvers, Mass.*



File Negs Behind the Photos

If you use adhesive corners to mount photos in an album, you can store the negatives behind the corresponding prints. When you need a print, the negative is then at hand. If necessary, trim the negative.—*H. E. Peterson, New Britain, Conn.*

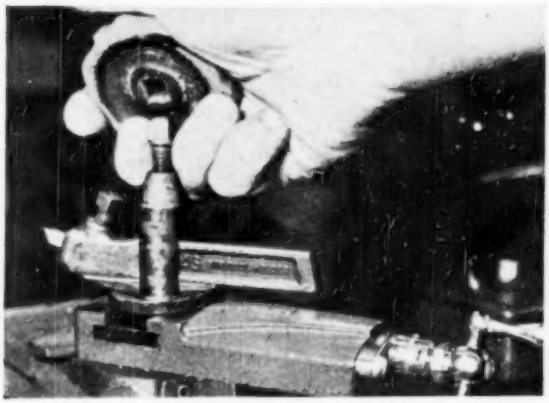
My Most Ingenious Solution

We were stuck in our country cottage. The only lights we had were kerosene lamps. The kerosene can was empty and there was only a little oil in one lamp—so little that it wouldn't reach the wick. What do you think I did?

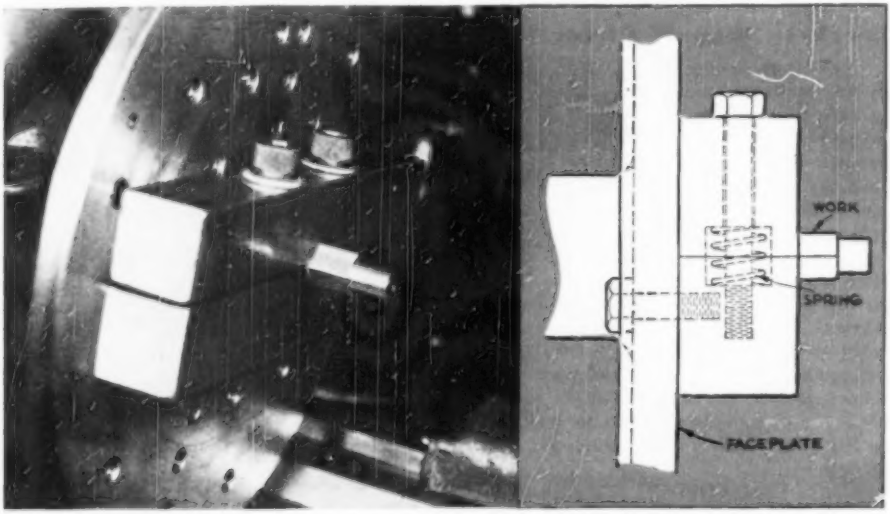
I ran water into the lamp. The kerosene floated on the water and reached the wick. There was enough oil in the lamp to see us through the night.—Donovan Merry, Hillsboro, Ill.

NEW SHOP IDEAS

Paint On a Safe Edge. Instead of using an ordinary file when you have a job that requires a file with a safe edge, try this dodge. Simply coat one or more file faces with sodium silicate, commonly called water glass, and let it dry. Add more coats if necessary to cover coarse teeth. This forms a hard, smooth coat. It can be removed any time with a file card or a wire scratch wheel. *—Will Thomas, Buffalo.*



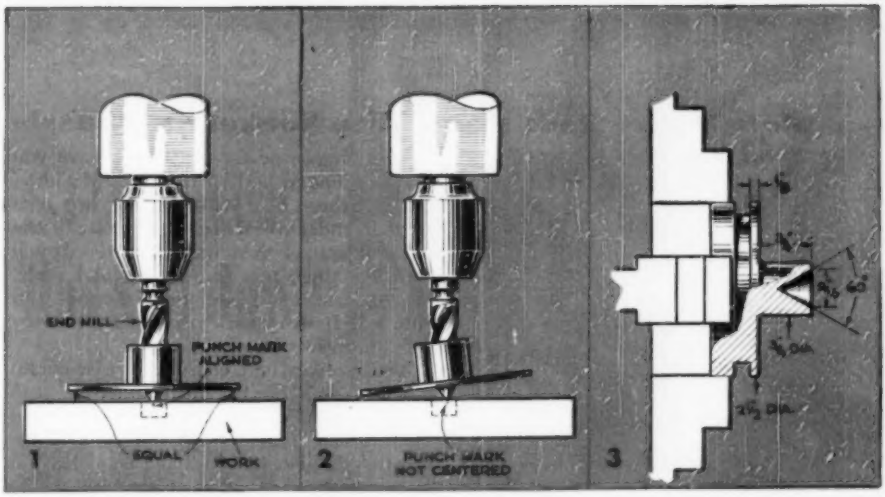
Wheel Tightens Tool Post. In the course of constant changing and setting of lathe tools, the wrench has a way of getting mislaid. And if it's left on the tool post, it gets in the way. A valve or faucet handwheel with a square hole makes a handy substitute. It's less awkward if left on the post, and is faster in use because you needn't shift it to another grip on the bolt head. *—John M. Avery, Dexter, N. Y.*



Fixture Centers Square Stock. It's slow work to center many pieces of square stock in a four-jaw chuck. This fixture need be set up only once; then every piece will automatically be centered.

It consists of two blocks, each with a 90° V milled in the middle of one face. The lower block is tapped for bolts that hold it on the faceplate, and also for two ⅜″ Allen cap screws that clamp the upper block to it. Springs set in matching blind holes open the blocks when the screws are loosened.

The fixture can be centered by clamping a piece of round stock in the V, putting an indicator or wiggler on it, and making it run true.*—J. C. Magee, Schenectady.*

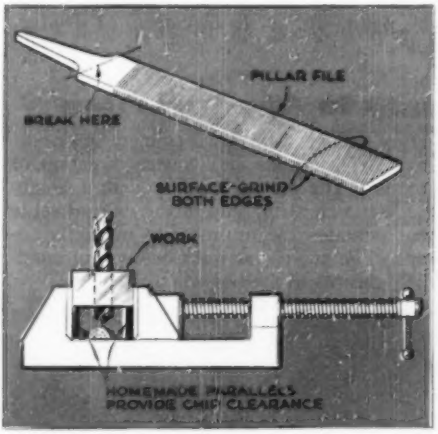


Disk Finder Aligns Work. A timesaver on jobs set up from a punch mark, this finder can be used on a vertical mill, drill press, or lathe. If a groove is to be machined with an end mill, for example, the mill is set into the finder and the point set in the punch mark. If the latter is centered under the spindle, the disk will be equidistant from the work face all around (Fig. 1). If not, misalignment shows up as in Fig. 2.

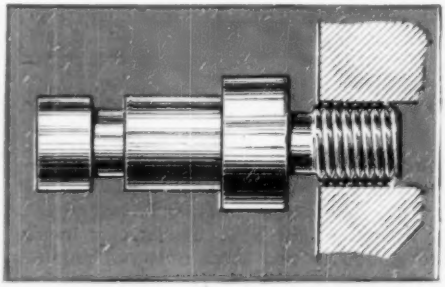
A level, a surface gauge, or calipers can be used on the finder rim. In the lathe, a ½" rod in the tailstock chuck mounts it.

To make the finder, chuck a 1¾" length of shafting or other stock that will finish to 2½" diameter. Turn it as in Fig. 3, leaving the rim ⅛" thick. Then turn the piece around and grip it in the four-jaw chuck on the ¾" shoulder, using an indicator on the inside face and edge of the rim.

Rough-turn to shape without touching these surfaces. Indicate once more, and then turn the 60° point and machine the rim to 1/16" thickness, taking light cuts. Break all corners; then finish with emery and oil. *—Jesse R. Lucas, Michigan City, Ind.*



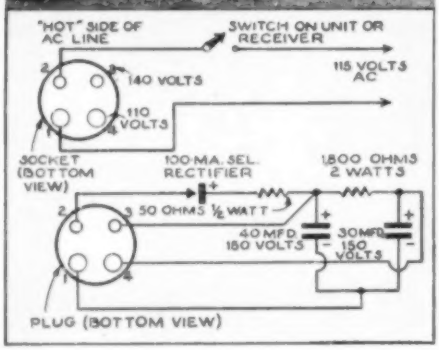
Grind Parallels from Files. You'll find many uses for parallels when you have them around. If you have access to a surface grinder, it's easy to make good parallels from old pillar files. As the edges of these don't taper, moderate grinding trues them up. Teeth can usually be left on. *—Arthur R. Morgan, Naugatuck, Conn.*



Chucking on Threads. Sometimes the only place a piece of work can be gripped is on threads. To prevent chuck jaws from marring them, I wrap a few turns of wire in the threads. The wire must fit into the V of the thread yet project slightly above. *—Jim Blizzard, Marshall, Ill.*

Clearing Chips. When drilling closed containers or blind holes, you can often remove chips with cellulose tape. Wind it on a small rod, sticky side out. It will remove nonferrous chips, which a magnet won't. *—George R. Mulderick, Corry, Pa.*

Complete Power Unit Plugs Into Socket on Chassis



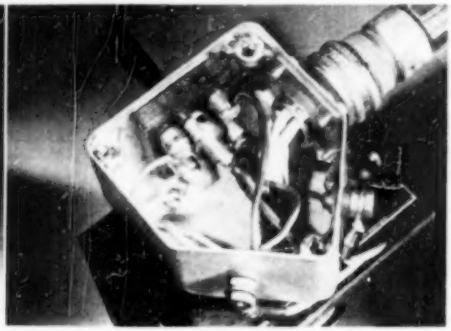
This plug-in power supply can save you space or time or both in your radio-building work. If there isn't room for the parts of a rectifier under a small chassis, you can use this unit to stack them upright on top. It will save you time, too, on experimental work, for you can build one power supply and switch it from chassis to chassis with very little trouble.

The rectifier unit consists of a selenium rectifier, dual electrolytic condensers, and two resistors, mounted inside a discarded vibrator can. The photo shows the arrangement of the selenium disk and condenser. A terminal strip is attached at the point where the two units meet. One lug of the strip is used to anchor the 1,800-ohm resistor; another lug serves as a common ground. The whole unit is wrapped in insulating material before being inserted in the can.

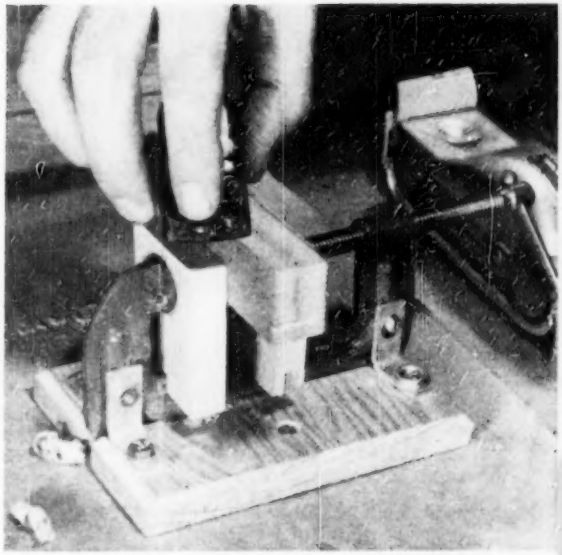
To use the power unit with a small receiver, mount a 4-prong socket on the receiver chassis. Connect pin 2 to the "hot" side of the AC line through a switch, and wire pin 1 to the chassis or other common ground. You can then tap your filtered B-plus voltage (about 110 volts) off pin 4. Should you want a higher, less-filtered voltage for the plate of an output tube, use pin 3. There should be about 140 volts available at this point.—*Homer L. Davidson, Ft. Dodge, Iowa.*

Remote-Control Tractor Runs in Any Direction

A single lever controls forward, backward, and steering movements in this remote control for toy vehicles. The control and the tractor were built by P. J. Durham, of Kew Gardens, N.Y. The tractor treads are geared to two small universal motors, each having three leads. One is the common return and the other two connect to opposing field windings and govern direction of rotation. The motors are linked to a home-made switch at the end of the control cable that actuates the appropriate motor windings. The switch, at right below, automatically returns to neutral when released.



C-Clamp Vise Has Soft Jaws



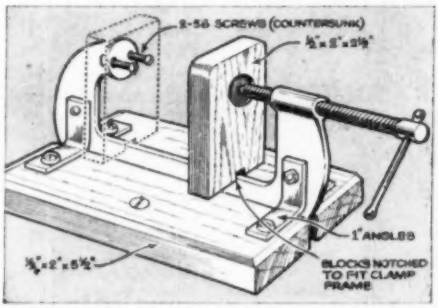
THE regular heavy-duty shop vise has many uses, but for light work it is often too cumbersome and unwieldy. Its hard metal jaws may scratch or damage delicate parts, or steal heat away from pieces you are trying to solder.

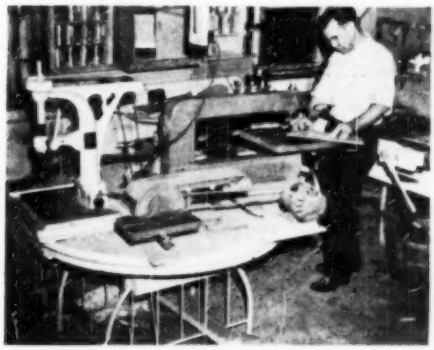
Because it overcomes these disadvantages, the C-clamp vise pictured above can be a useful tool in many shops. If you have an extra 3" clamp in your workshop, the cost is practically nothing; but even if you have to buy the parts, it will be hard to spend more than half a dollar on them.

Use an inexpensive clamp of the type made from steel stampings (the heavier cast-iron clamps generally have stubby jaws and frames that are harder to drill). Cut two hardwood blocks for the frame and attach them firmly to the clamp with right-angle brackets.

To provide a large, flat gripping surface, fit wooden pads to the jaws of the clamp. Fasten the stationary pad with countersunk machine screws; to hold the other block, drill a blind, undersized hole and press it over the round foot on the clamp screw. Notch both pads to fit over the clamp frame. *–Arthur C. Miller, N. Bergen, N. J.*

For model work this C-clamp vise is often handier than the regular shop vise. It can be screwed or clamped to the bench. To assemble it, you have to drill holes through the frame and stationary jaw. Use a high-speed drill.





Rotary Table Saves Shop Space

MY WORKSHOP had become so crowded that I found it hard to get at my tools until I made my tools come to me. I used the top of a round oak dining table, the legs from a metal bed, and two steel bearing plates to make the power-tool turntable shown at the left. Around the table I mounted a 24" jigsaw, a drill press, belt sander, and wood lathe. Electrical cables for the motors come up through the center of the table. I attached a stop to the table so it can't pull the wires loose.–*T. H. Lavengood, So. Bend, Ind.*

Are You Saving Popular Science Data Cards?

Published at frequent intervals, they give you useful information for solving home and shop problems.

HOW long is an eight-penny nail? What are the actual dimensions of a two-by-four? How can you clean wallpaper? What is the outside diameter of 1″ pipe? How would you draw a five-pointed star? What

COMMON CHEMICALS 1

COMMON NAME	CHEMICAL NAME	SYMBOL
Alcohol	Ethyl alcohol or ethanol	C_2H_5OH
Alum	Aluminum potassium sulphate	$AlK(SO_4)_2.12H_2O$
Alumina	Aluminum oxide	Al_2O_3
Aqua ammonia	Ammonium hydroxide solution	NH_4OH+H_2O
Aqua fortis	Nitric acid	HNO_3
Aqua regia	Nitric and hydrochloric acids	HNO_3+HCl
Aspirin	Acetylsalicylic acid	$C_2H_3O_2C_6H_4CO_2H$
Baking soda	Sodium bicarbonate	$NaHCO_3$
Banana oil	Amyl acetate	$CH_3CO_2C_5H_{11}$
Baryta	Barium oxide	BaO
Blacklead	Graphite (mineral carbon)	C
Bleaching Powder	Calcium hypochlorite	$CaOCl_2$
Blue copperas, Bluestone, Blue vitriol	Copper sulphate	$CuSO_4.5H_2O$
Boracic acid	Boric acid	H_3BO_3
Borax	Sodium borate	$Na_2B_4O_7.10H_2O$
Brimstone	Sulphur	S
"Butter of"	Chloride or trichloride of	
Calomel	Mercurous chloride	Hg_2Cl_2
Carbolic acid	Phenol	C_6H_5OH
Carbonic acid	Carbon dioxide	CO_2
Caustic potash	Potassium hydroxide	KOH
Caustic soda	Sodium hydroxide	$NaOH$
Chalk	Calcium carbonate	$CaCO_3$
Chile saltpeter	Sodium nitrate	$NaNO_3$

FOR YOUR POPULAR SCIENCE INFORMATION FILE

COMMON CHEMICALS 2

COMMON NAME	CHEMICAL NAME	SYMBOL
Chloride of lime	Calcium hypochlorite	$CaOCl_2$
Chrome alum	Chromium potassium sulphate	$CrK(SO_4)_2.12H_2O$
Copperas	Ferrous sulphate	$FeSO_4.7H_2O$
Corrosive sublimate	Mercuric chloride	$HgCl_2$
Cream of tartar	Potassium bitartrate	$KHC_4H_4O_6$
Crocus powder	Ferric oxide	Fe_2O_3
Dry ice	Carbon dioxide	CO_2
Dutch liquid	Ethylene dichloride	$(CH_2Cl)_2$
Emery powder	Impure aluminum oxide	Al_2O_3
Epsom salts	Magnesium sulphate	$MgSO_4.7H_2O$
Ether	Ethyl ether	$(C_2H_5)_2O$
Fluorspar	Natural calcium fluoride	CaF_2
French chalk	Natural magnesium silicate	$H_2Mg_3(SiO_3)_4$
Galena	Natural lead sulphide	PbS
Glauber's salt	Sodium sulphate	$Na_2SO_4.10H_2O$
Grain alcohol	Ethyl alcohol or ethanol	C_2H_5OH
Green vitriol	Ferrous sulphate	$FeSO_4.7H_2O$
Gypsum	Natural calcium sulphate	$CaSO_4.2H_2O$
Hypo	Sodium thiosulphate	$Na_2S_2O_3.5H_2O$
Javelle water	Sodium hypochlorite solution	$NaOCl+H_2O$
Laughing gas	Nitrous oxide	N_2O
Lime	Calcium oxide	CaO
Limewater	Calcium hydroxide solution	$Ca(OH)_2+H_2O$
Litharge	Lead oxide	PbO
Lunar caustic	Silver nitrate	$AgNO_3$

FOR YOUR POPULAR SCIENCE INFORMATION FILE

is meant by the pitch diameter of a screw? How should you file a ripsaw?

Answers to all these questions, and hundreds more, have been contained in recent years on POPULAR SCIENCE information cards like the four cards that give chemical designations below.

You may not need (or care) to know that the chemical name of bleaching powder is calcium hypochlorite right now. But a year from now it may be very useful.

A reference file started now will keep this and other valuable information at your fingertips. POPULAR SCIENCE information data are always published in the same size—just right for clipping and pasting on three-by-five file cards for permanent storage in a card-file box.

COMMON CHEMICALS 3

COMMON NAME	CHEMICAL NAME	SYMBOL
Lye	Sodium hydroxide	$NaOH$
Magnesia	Magnesium oxide	MgO
Marble	Calcium carbonate	$CaCO_3$
Methylated spirits	Methyl alcohol or methanol	CH_3OH
Milk of magnesia	Magnesium hydroxide in water	$Mg(OH)_2$
Minium	Lead tetroxide	Pb_3O_4
"Muriate of"	Chloride of	
Niter	Potassium nitrate	KNO_3
Oil of mirbane	Nitrobenzene	$C_6H_5NO_2$
Oil of vitriol	Sulphuric acid	H_2SO_4
Oleum	Fuming sulphuric acid	$H_2SO_4+SO_3$
Pearl ash	Potassium carbonate	K_2CO_3
Peroxide	Peroxide of hydrogen solution	$H_2O_2+H_2O$
Plaster of Paris	Calcium sulphate	$(CaSO_4)_2.H_2O$
Plumbago	Graphite (mineral carbon)	C
Prussic acid	Hydrocyanic acid	HCN
Pyro	Pyrogallic acid	$C_6H_3(OH)_3$
Quicklime	Calcium oxide	CaO
Quicksilver	Mercury	Hg
Red lead	Lead tetroxide	Pb_3O_4
Rochelle salt	Potassium sodium tartrate	$KNaC_4H_4O_6.4H_2O$
Rouge	Ferric oxide	Fe_2O_3
Sal ammoniac	Ammonium chloride	NH_4Cl

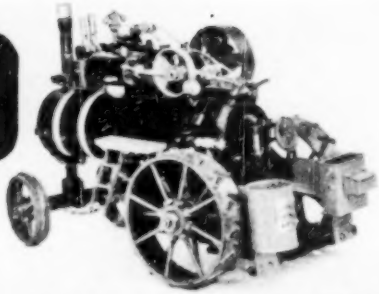
FOR YOUR POPULAR SCIENCE INFORMATION FILE

COMMON CHEMICALS 4

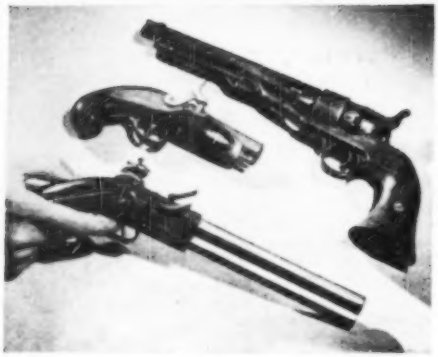
COMMON NAME	CHEMICAL NAME	SYMBOL
Saleratus	Sodium bicarbonate	$NaHCO_3$
Sal soda	Crystalline sodium carbonate	$Na_2CO_3.10H_2O$
Salt	Sodium chloride	$NaCl$
Saltpeter	Potassium nitrate	KNO_3
Salts of lemon	Potassium binoxalate	$KHC_2O_4.H_2O$
Silica	Silicon dioxide	SiO_2
Slaked lime	Calcium hydroxide	$Ca(OH)_2$
Soda ash	Dry sodium carbonate	Na_2CO_3
Spirits of salts	Hydrochloric acid	HCl
Spirits of wine	Ethyl alcohol or ethanol	C_2H_5OH
Sugar of lead	Lead acetate	$Pb(C_2H_3O_2)_2.3H_2O$
"Sulphuret of"	Sulphide of	
Sulphuric ether	Ethyl ether	$(C_2H_5)_2O$
Talc	Magnesium silicate	$H_2Mg_3(SiO_3)_4$
Vinegar	Dilute, impure acetic acid	CH_3COOH
"Vitriolate of"	Sulphate of	
Washing soda	Crystalline sodium carbonate	$Na_2CO_3.10H_2O$
Waterglass	Sodium silicate	Na_2SiO_3
White arsenic	Arsenic trioxide	As_2O_3
White lead	Basic lead carbonate	$(PbCO_3)_2.Pb(OH)_2$
White vitriol	Zinc sulphate	$ZnSO_4.7H_2O$
Whiting	Powdered calcium carbonate	$CaCO_3$
Wood alcohol	Methyl alcohol or methanol	CH_3OH

FOR YOUR POPULAR SCIENCE INFORMATION FILE

CRAFTSMEN AT WORK

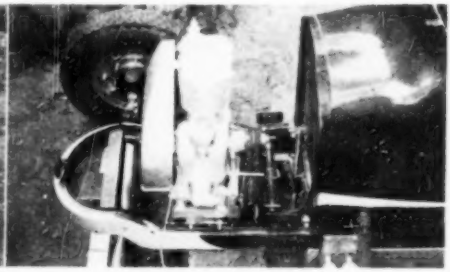


Engine Built Without Castings. This 40-lb. model of the strange-looking machines that helped turn the prairies into the world's breadbasket runs under its own steam. Nearly every part was machined from scrap by George Grivna, of Minneapolis, who devoted more than 1,000 hours to building it. The 12″ by 14″ by 22″ engine has a friction clutch and transmission.

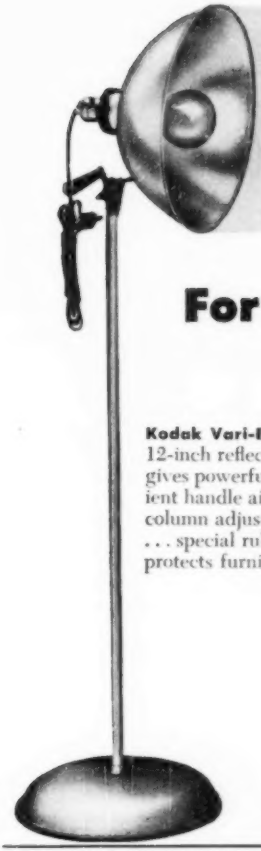


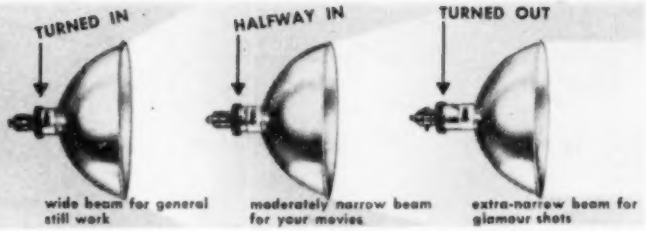
Antique Guns Made of Wood. High-caliber craftsmanship and attention to detail can be seen in every line of these beautiful carved gun models. The same painstaking work went into finishing them. Leonard Cronk, of Valhalla, N. Y., used white wood for the barrel and action of the 1860 Colt, top. He then copper-plated the wood and oxidized the copper with a potassium sulphide solution. Steel wool helped to antique the oxide. Aluminum paint, lightly covered with raw umber, simulates the metal parts of the Derringer and the double-barreled belt pistol.

Tiny But Fast. This small motorized bike outpaces most of the big-wheel pedal jobs in town. John Molnar, Jr., of St. Louis, built it when he was 12 years old. He used a ¾-hp. Briggs and Stratton engine, adding a clutch and an idler gear. A 4-to-1 drive ratio provides speeds up to 25 m.p.h.



Midget Car Has Racer's Lines. Fletcher Fish, of Hillsdale, N. J., devoted two years of spare-time work to the construction of this car. The frame is channel iron and the body aluminum. Most of it was formed over handmade wooden patterns. Mechanical parts include a 1½-hp. engine, a 1934 Ford rear end and drive shaft, and a Chevrolet steering gear. The motor is mounted on a hinged plate that can be raised or lowered by a lever in the cockpit. When raised, the motor tightens two drive belts. Despite its small power plant, the car has a top speed of 15 m.p.h.





For "on-the-beam" flood shots
KODAK VARI-BEAM

Kodak Vari-Beam Standlight—
12-inch reflector with a #2 flood lamp gives powerful illumination . . . convenient handle aims the lamp . . . telescopic column adjusts height from 3 to 5½ ft. . . . special rubber rim on heavy base protects furniture. $15.

Kodak Vari-Beam Clamplight—
lamp unit has all the features of the Vari-Beam Standlight unit, but is mounted on flexible bracket. Padded clamp attaches quickly and securely to chair backs, table tops, and tubular surfaces. $9.75.

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Flash pictures taken with multi-unit flash illumination have a more pleasing, natural look. You eliminate possibility of burned-out highlights and dense shadows in flash shots this easy way:

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Then connect a KODAK FLASHOLDER EXTENSION UNIT, MODEL B. Attach to a chair for side lighting. More than one unit can be used. $12.75.

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You can make these between now and Christmas if you get started soon! Send today for *Free* Idea Packet No. 312, which includes instruction sheets for these and other handsome workshop projects. The woods of the Western Pines* are light, easy to nail and shape, and finish up beautifully. And their straight, even grain, luxurious texture and distinctive appearance add beauty to the most simple article.

Use these inspiring Western Pines* to build in charm in halls and dining room, to reclaim idle space for dens and bunk bedrooms, or to remodel a kitchen. New, colorful booklet, "Enchanted Homes of Western Pines," has 71 photographs suggesting ways to use these versatile woods. Write Western Pine Association, Dept. 312-L, Yeon Bldg., Portland 4, Oregon.

These are the Western Pines
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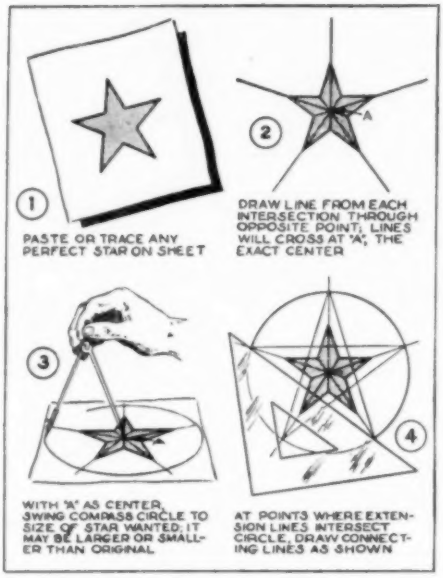
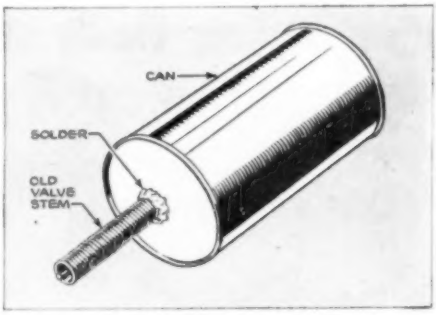
* PONDEROSA PINE
* SUGAR PINE



How to Draw Perfect Stars

It's practically impossible to draw perfect five-pointed stars freehand, but they're not hard to make if you know this simple trick. Start with a well-formed star of any size—it can be a gummed label or a tracing—and follow the steps illustrated. Determine the size of the star you want and set the compass accordingly.



Tire Valve Makes Oil Can

For lubricating small parts, you can use an old tire valve. File down the end so the core projects slightly. Then solder the valve stem in a hole in the bottom of a small can. Such an oil container will release one drop of oil at a time.—*Pfc. Raymond De Busk, Fort Lewis, Wash.*

Compact industrial television system--developed at RCA Laboratories—lets us see the unseeable in safety!

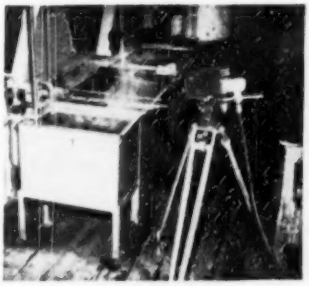
Eye-witness reports from a fiery furnace!

Something's gone wrong in a big blast furnace, and heat is too high for engineers to approach. Focus the Vidicon camera of an RCA Industrial Television System on the flames and the furnace can be studied on a television receiver.

This is only one suggested use, for RCA's compact industrial television system is as flexible as its user's ingenuity. "Eye" of the tiny camera—small enough to be held in one hand—is the sensitive Vidicon tube. Extremely simple, the only other equipment needed is the Vidicon camera's suitcase size control cabinet, which operates anywhere on ordinary household current.

The Vidicon camera could be lowered under water where divers might be endangered—or stand watch on atomic chain reactions, secure from deadly radiations. And it is entirely practical to arrange the RCA Industrial Television system in such a way that observers can see a *3-dimensional picture* . . . sharp, clear and real as life!

See the latest wonders of radio, television, and electronics in action at RCA Exhibition Hall, 36 West 49th St., N. Y. Admission is free. Radio Corporation of America, Radio City, New York.



Here's RCA's Vidicon system at work beside a steaming vat. Note how the compact television camera is getting a safe "close-up" of the action.

RADIO CORPORATION of AMERICA

World Leader in Radio — First in Television

SHOPSMITH OUTPERFORMS SAWS, SANDERS, LATHES, DRILL PRESSES COSTING $500.00

It's a performance-proved fact! With SHOPSMITH you can do more jobs, actually do better work, than with any $500 combination of single-purpose tools with motors. And here's why:

SHOPSMITH IS VERSATILE! It converts into five big, heavy-duty power tools. Takes all standard accessories. Can do 116 wood, plastic and metal working operations.

SHOPSMITH IS EASY TO OPERATE! Even without practice you can change it from tool to tool *in less than sixty seconds.*

SHOPSMITH TAKES BIG WORK! Its effective table width is so great you can saw to center of 8-foot plywood panels, sand and drill room-length pieces—*with no interference from other tools.* Lathe turns work bigger than a nail keg.

SHOPSMITH IS PRECISION-BUILT! It combines features found only in the finest tools. Grease-sealed ball-bearing action. Induction hardened spindle tip. Centerless ground steel ways. A score of precision features that assure hairline accuracy, lifetime service.

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complete except for motor. With special, ½-hp., capacitor type motor (shown). . $199.50

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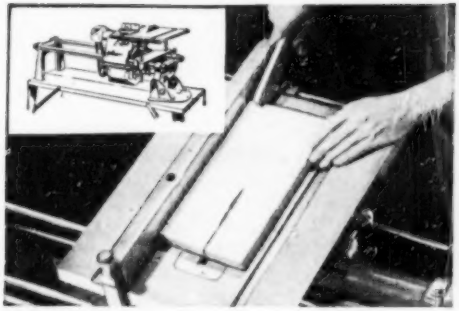
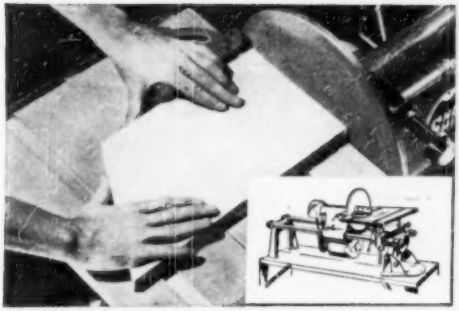
The finest precision jigsaw you could own

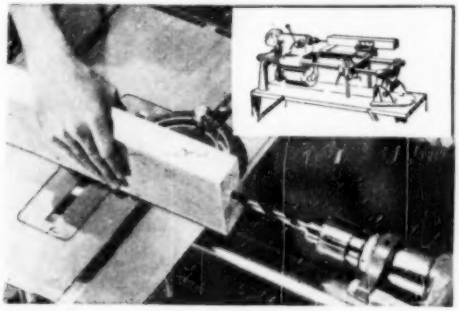
Rugged construction. 18" throat. Large tilting table. Built-in blower. Attaches quickly with one bolt. Can be used also for saber sawing, machine filing. Complete attachment, $34.95



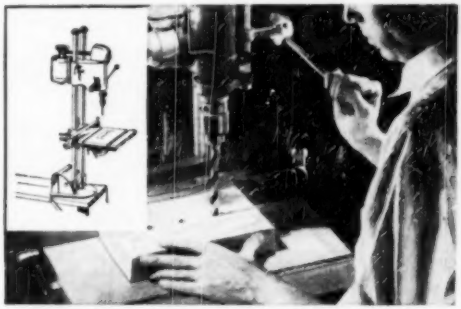
1 8-inch Circular Saw. You'd pay $120 for a saw of equal quality, equal capacity. Effective table width, fence to blade, up to 48". Depth of cut 2¼". Sturdy tilting table with ball-crank raiser. Precision-tooled miter gauge with automatic stops. Self-aligning rip-fence.



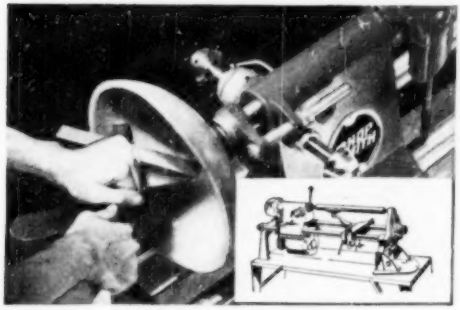
2 12-inch Disc Sander. No other disc sander can match it. None has 12" precision balanced disc, 14½" x 17" tilting table, both miter gauge and fence. And with SHOPSMITH you can feed disc into workpiece with feed lever for greater accuracy, speed and safety.



3 Horizontal Drill Press. Ever try to drill the end of a table leg? Dowel stock for table tops? Mortise doors for locks? You can do it quickly and easily with SHOPSMITH. Work lies flat on table, no special jigs needed. Speeds from 875 to 3500 rpm. 4" quill feed.



4 Vertical Drill Press. In vertical position, SHOPSMITH is both a bench and floor-type drill press. Drills to center of 15" circle. Has 4" spindle feed with right or left hand feed lever. Jacobs key chuck takes drills from 5/64" to ½" in diameter. Extra-large table.



5 33-inch Wood Lathe. Turns stock up to 15" in diameter, 3" more than most heavy-duty lathes. Swivel-arm tool rest slides parallel to ways, lever-locks in position. Absolutely rigid lathe bed assures maximum accuracy—tubular steel ways each take over one-ton stress.

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A Professional Carpenter's Saw

6" model cuts 2"—Only $65.
8" model cuts 2⅞"—Only $87

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No other saw offers all the value-features of Guild: the new built-in tilting adjustment with easy-to-read quadrant giving angle setting up to 45°; new quick depth regulator which allows base to be raised or lowered by a mere twist of the knob; efficient helical gear drive; precision ball bearings; retractable safety guard; polished aluminum frame.

Look over both saws—decide which best suits your purpose—then take advantage of one of the most sensational value offers ever made. MAIL COUPON TODAY.

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2310 N. Salina St. Syracuse 8, N. Y.

Gus Has a Noisy Day

[*Continued from page 192*]

who had been sitting on the side porch with his wife and Mrs. Miller, bounded down the steps.

"Did you fix her?" he called, and then, before Gus could answer, he said, "Gosh, she sounds perfect, doesn't she? Hope she stays fixed this time."

"She will. I'll guarantee that," Gus said as he handed Wilkins the keys. "I don't think you'll have any more trouble."

"What are the damages, Gus?" Wilkins asked, reaching into his hip pocket for his wallet.

"Oh," Gus shrugged, "three dollars ought to about cover it."

"Three dollars—that hardly seems like enough."

"It'll be more than enough to cover what I did."

"I don't understand," said Wilkins.

"Well, to tell you the truth," admitted Gus, "I didn't understand it either when you first started the engine back at the garage. As a matter of fact, it had me pretty well stumped until about 20 minutes ago.

A Puzzle in Valves

"You see, that clatter, as you called it, sounded just like the noise made by an old overhead-valve engine with tappets badly in need of adjustment. But I knew that couldn't very well be because your engine, like a good many modern ones, is fitted with hydraulic valve lifters."

"Hydraulic what?"

"Hydraulically operated expansion and contraction units placed between the cam shaft and the push rods that open the intake and exhaust valves," explained Gus. "Supplied with oil from the engine lubricating system, the hydraulic valve lifters adjust their own length to make up for any variation in the length of the push rods, rocker arms, or valves. Each hydraulic lifter keeps its valve mechanism at the proper tension so there is no clearance between the various parts, and naturally, there is no valve noise."

One look at the puzzled frown on Tom Wilkins' face told Gus that he'd need more than words to get the idea across.

"Here, I'll sketch it," Gus said, pulling an old envelope out of his overall pocket, and starting to draw with the stub of a pencil he always carried. "First of all, we have

[*Continued on page 248*]

CORALOX STANDS HEAT BETTER!

The cloth couldn't stand the heat of the iron.

But, with *CORALOX*, it's different. (*CORALOX*, you know, is the new, patented Insulator used in all AC Spark Plugs.)

When you're driving, the lower ends of your spark plug insulators are subjected to terrific temperature punishment. As often as 30 times a second, the temperature in the combustion chambers see-saws between the 4,000 degrees of burning fuel and the coolness of incoming, new fuel.

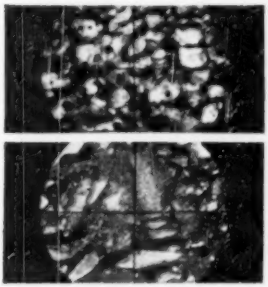
The insulator must also be able to carry away heat. If it's too slow, the insulator tip overheats. Then, fuel preignites. Both fuel and power are wasted. If it dissipates heat too fast, the insulator tip runs too cool and oxide coatings form, producing intermittent "missing" at high speeds and on hard pulls; or while your engine is warming up, or in "stop-and-go" driving, the insulator tip becomes fouled with oil and carbon.

CORALOX keeps itself amazingly clean—under all driving conditions—because it stands heat better.

Thanks to their patented *CORALOX* Insulator, you get more reliable performance, better pick-up, improved fuel economy, less fouling, and better idling—with AC Spark Plugs.

AC SPARK PLUG DIVISION • GENERAL MOTORS CORPORATION

Microphoto Reveals One Reason Why *CORALOX* Stands Heat Better



These two unretouched photographs show the structure of *CORALOX* (top), and of insulator material in use before *CORALOX* (lower). Both are magnified 500 times.

In the first, the *CORALOX* crystals nestle close together. Heat can pass quickly and easily from one to another. This structure, also, is extremely strong.

In the second, the insulator material suffers from the presence of a high proportion of glass because this material was made from clay. Glass is a poor conductor of heat. It is also fragile. (The large gray area in the center of the photo is glass.)

Learn MORE about *CORALOX*

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PATENTED *CORALOX* INSULATOR

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Gus Has a Noisy Day

[*Continued from page 246*]

a cylinder fitted with a ball valve that opens and closes an oil-intake hole. A piston, or plunger, that fits into this cylinder is held in its uppermost position by a light spring. This leaves a small chamber in the bottom of the cylinder, below the plunger."

Wilkins, following Gus's rough sketch, nodded.

"Now, this whole unit is mounted between the cam shaft and push rod, with the end of the push rod resting on the top of the plunger and the bottom of the cylinder resting on the cam. The chamber between the plunger and the bottom of the cylinder is kept filled with oil from the engine lubricating system.

"At the start of the valve-opening operation," Gus continued, "the pressure against the plunger and the plunger against the column of oil closes the ball valve and the entire lifter operates as a solid unit. Then, during the actual valve opening, a slight amount of oil is allowed to leak out between the plunger and the cylinder wall. Finally, at the valve-closed position, the pressure on the plunger is reduced, the ball valve opens, and more oil enters the chamber.

Mr. Wilkins Catches On

"Sort of works like an automatic hydraulic jack, doesn't it?" said Wilkins.

"That's right," agreed Gus. "Each hydraulic valve lifter automatically adjusts its length with each revolution of the camshaft to compensate for expansion or contraction caused by variations in engine temperatures. The use of hydraulic valve lifters has eliminated the clackety-clack of valve systems."

"Well, this engine sure had it," put in Wilkins, grinning.

"I know it did, and that's what bothered me," said Gus. "Then, as I fussed with the engine, two facts began to fit together. I noticed that the longer I idled it the less pronounced the noise was. I also remembered that last Monday morning, when you had your trouble, was also a bit on the chilly side, like today."

"Guess I'm dumb, but I still don't see any connection."

"Remember," Gus pointed out, "these valve lifters work with engine oil. By the way, Mr. Wilkins, when did you drain your

[*Continued on page 250*]

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AUTO-LITE Sta-ful BATTERY... *needs water only 3 times a year*

IN NORMAL CAR USE

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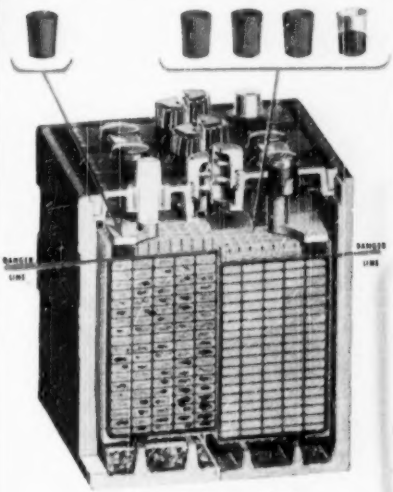

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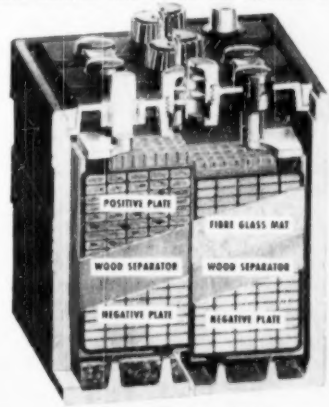
Note how the protective Fibre-glass mat retains the power-producing material in the positive plate while ordinary battery plates shed the active material until it fills the sediment well.



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Gus Has a Noisy Day

[Continued from page 248]

summer oil and put in a cold-weather grade?"

"I haven't yet," admitted Wilkins.

"And that was your trouble," said Gus, "and why I changed the oil for you. On these snappy mornings it takes a bit of time for heavy summer oil to loosen up, and until it does, the flow of oil to the valve lifters is apt to be slowed down. Without a free flow of oil they don't compensate, and you get valve noises.

"There's another factor, too," Gus added. "When a motor sits long enough, or in just the right position, oil is likely to drain out of the chambers and isn't replenished until the oil warms up and flows freely."

"Well how the deuce did that mechanic down the road get rid of the noise to the tune of 20 bucks?" asked Wilkins.

What He Got for His $20

"Simply by doing next to nothing," grinned Gus. "Unless I miss my guess, you hadn't got back to the hotel before he had your car out on the road, driving it just long enough and fast enough to get it up to operating temperature. Once the oil thinned out, the noise was gone. Then, all he did was sit around and wait for you to call for your car—and pay him $20 for his trouble."

"Why, the dirty crook," boomed Wilkins.

"Now you see, Tom," chimed in Mrs. Miller, who hadn't been able to resist the temptation of joining the two men. "It's just as I said. You were cheated and you ought to do something about it."

"I'll sure enough know what to do the next time some guy wants to fuss around with the valves," said Wilkins.

"And don't be too cocky about that, either," warned Gus. "Like any moving part, hydraulic valve lifters do need some attention now and then. The important thing is to watch the condition of your oil. Just remember that valve lifters can't operate as they should if the oil is too heavy for the time of year or if the oil is dirty. It's also mighty important to change your oil filter every 5,000 miles.

"It's like everything else about a car," Gus added. "So far no engineer has been able to devise a mechanical substitute for care and common sense."

And, thought Gus as he started walking back to the garage, no one yet has devised anything—mechanical or otherwise—to silence Mrs. Miller. END

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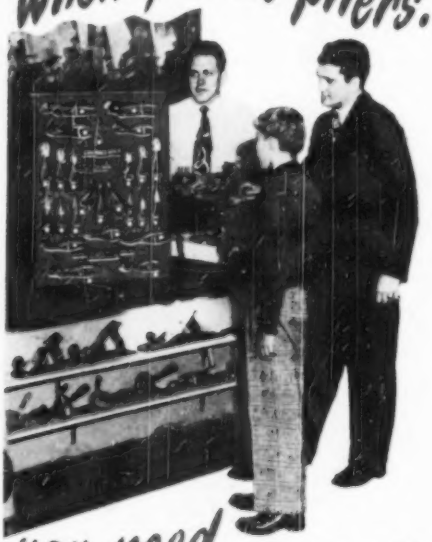

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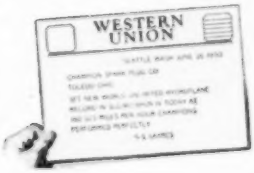
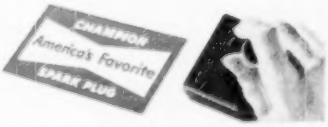


Here is the news that electrified the speedboat world recently. The new record broke the old mark, which has stood since 1939, by over 18 miles per hour.

Mr. S. S. Sayres, owner and driver of Slo-Mo-Shun IV, is a qualified expert on engine performance, and his choice of dependable Champion Spark Plugs for his world's record speed run speaks for itself.



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☐ Enclosed is $14.95 (check or M.O. in full.) Rush 3-in-1 Jig Saw POST PAID.
☐ Enclosed is $2.00 part payment. I will pay postman balance plus postage on C.O.D. delivery.
☐ Enclosed is $ ..... (check or M.O. in full.)
Rush Group Nos ..... Project Patterns at $1.00 each POST PAID.

Name .....
Address ..... Zone .....
City ..... State .....

Mechanics of Farming

By Ladd Haystead

■ Is a weedless nation possible? A U.S. Dept. of Agriculture agronomist, L. M. Stahler, has suggested that it is. Over 25 million acres in the Mississippi Valley were treated with 2,4-D last year. Already some of the most troublesome regional weed species, such as wild mustard and cockleburs, seem to be retreating. In the humid areas, field bindweed, Canadian thistle, and perennial sow thistle are vanishing rapidly.

■ Until recent years, it has been the custom to leave crop refuse in the fields to be weathered down and eventually plowed under in the spring. But such stalks, after serving as winter nesting places for pests, more often than not were still there in spring to foul up tillage tools. Usually they did not rot and return their residual values to the soil until the following year. Today, fall plowing and stalk burying are finding favor in many parts of the country. With this new practice comes the advisability of a stalk shredder that will cut the residues into small pieces for complete burying and faster rotting. This Hurricane Stalk Shredder (Stewart & Stevenson Services, Houston, Texas) may be the answer. It is front-mounted, enabling shredding and plowing to be done in one operation.

■ Biological warfare comes to the fields. Two California scientists ground up the bodies of a few dozen alfalfa caterpillars that had died of a virus disease. The powdered

where are YOU in the Danger Zone

The More You Delay—The More You Pay

There's always danger ahead when piston rings wear out—danger of much greater expense unless new rings are installed promptly.

But if you *do* install new rings at the first symptom of wear, you can protect your engine and insure its long and economical life.

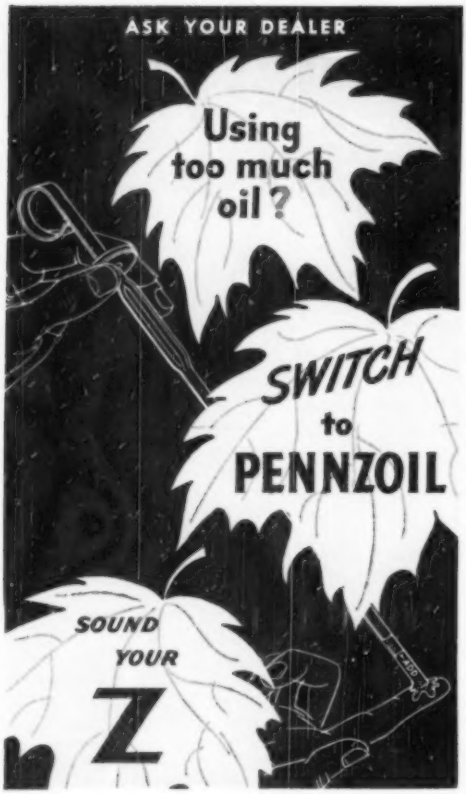
Check your own situation on the Danger Zone chart, with the help of your service man. This simple precaution may save you both money and headaches. For the more you delay the more you pay. And when you need new piston rings, get Hastings, the rings designed for replacement service. It's the best money you can spend on your car.

WARNING ZONE	DANGER ZONE 1	DANGER ZONE 2	DANGER ZONE 3
Engine loses pep . . .	Engine begins to smoke . . .	Engine pumps oil badly . . .	Destructive wear sets in . . .
Needs a tune-up	**Needs new piston rings and minor engine repairs**	**Needs new piston rings and major engine repairs**	**Needs new piston rings and complete overhaul**
Clean, adjust and re-time ignition. Clean fuel supply and carburetor screens. Adjust carburetor. Adjust tappets and fan belt. Check compression and vacuum readings for symptoms of ring wear.	Replace piston rings. Align rods. Adjust rods or replace rod bearings. Reseat and reface valves. Tune engine. These repairs are comparatively inexpensive and put the engine back in peak condition for thousands of economical miles. Delay puts the engine in Danger Zone 2.	Replace piston rings. Replace piston pins. Adjust—probably replace—main bearings. Align rods. Adjust rods or replace rod bearings. Reseat and reface valves. Tune engine. These repairs naturally cost more than those needed in Danger Zone 1, but they put the engine back in condition for thousands of additional miles of satisfactory service. Delay leads to costly Danger Zone 3.	Repairs cost three or four times as much as in Danger Zone 1. Remove engine. Recore cylinders. Replace pistons, pins, rings. Replace main bearings. Align rods, refit or replace rods, or replace rod bearings. Overhaul valve lifters, rocker arms. Replace timing chains or gears. Reseat, reface valves. Replace guides and springs. Replace camshaft bearings. Clean oil lines. Overhaul oil pump. Clean, re-install and tune engine.

HASTINGS

MANUFACTURING COMPANY
HASTINGS, MICHIGAN
HASTINGS LTD., TORONTO

STEEL-VENT PISTON RINGS



If you suspect you've been using too much oil, find out with your next oil change. Switch to Pennzoil, the 100% Pennsylvania motor oil that lasts longer, grade for grade.

Over 60,000 better dealers recommend Pennzoil at the yellow oval sign. Drive in now and sound your "Z" for genuine Pennzoil.

SOUND YOUR Z
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PENNZOIL
Safe Lubrication

Member Penn. Grade Crude Oil Assn., Permit No. 2

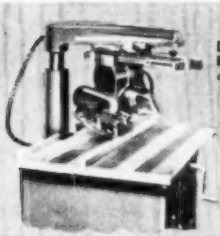
TOUGH-FILM PENNZOIL® MOTOR OIL & LUBRICANTS AT BETTER DEALERS . . . COAST TO COAST

bugs were put into water and the solution sprayed on infested fields from an airplane. A few weeks later, these fields were found to be nearly clean of caterpillars, victims of the virus that had killed the original group. Although chemicals can kill the caterpillars, most are also harmful to livestock. The virus is lethal only against the pests.

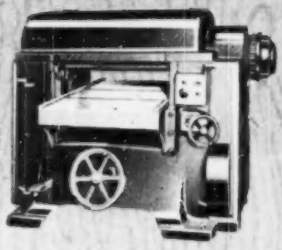
■ A new soil-erosion fighter is announced by the University of Illinois. The machine makes it possible to plant corn on land that is protected by a cover crop. Two 30-inch sweeps work two inches below the ground cutting the growing cover crop from the row. A 15-inch sweep below and behind each of these two loosens the soil at plow-sole depth. A 10-inch section of rotary hoe prepares the seedbed for planting. A planter shoe in each row, followed by fertilizer tubes, covering disks, and press wheels, completes the planting process, leaving a 10-inch swath of cover crop between each row of corn to hold the soil in place until the first cultivation.

■ A self-cooling grain bin has been tried out successfully by the Commodity Credit Corporation. It uses the venturi principle--a funnel with a cone-shaped top connected to a smaller tube. This is mounted on top of the bin and sucks the air up, reducing the temperature of the grain. Corn went into the bin in October at 33-percent moisture, usually enough to cause heating and spoilage. By Christmas, moisture was down to 20 percent, by mid-April it was 13 percent. No heating occurred.

■ The first plane designed specifically for farm work is under development at Texas A&M, and may be in the air on its first trials as this appears in print. Fred Weick, designer of the Ercoupe, is the man behind the aerial farm horse. It will probably be a single-seater, 200-hp., all-metal, low-wing monoplane with slotted flaps that will be able to get 50 feet off the ground in 1,000 to 1,320 feet, and climb at over 700 feet a minute. It will tote 800 pounds of payload. Hoppers will be plastic-coated, and synthetic-rubber bags will be used for gas and spray materials.



Delta Multiplex® Radial Arm Saw — one of four models.



Delta Crescent Planer — one of three Delta Crescent planers.

Delta-Milwaukee Tool Grinder — one of five Delta grinders.

DELTA MILWAUKEE® *Power Tools*

cut wood—cut metal—*cut costs!*

Delta-Milwaukee 14" Drill Press — one of 11 Delta drill presses.

Delta-Milwaukee 14" Band Saw — one of three Delta band saws.

Delta-Milwaukee 10" Tilting-Arbor Saw — The famous "Uni-saw"® — one of six Delta circular saws.

Talk about selection!

53 machines
246 models
More than 1300 accessories
— plus 14 Delta Homecraft® tools and accessories

Get the right tool for every job, in the *complete* line, the *quality* line, the *leading* line

Whether you work in wood or metal, whether your shop is big or little, Delta tools offer you: low first cost, low upkeep, high output. The reason? Quantity production of quality tools, backed by years of safe and successful operation in schools, industrial plants, commercial shops, and homes.

See for yourself how these tools can help you cut costs. Ask your Delta dealer for a demonstration. And send the coupon today for the complete catalog, showing and describing the tools that fit your job and budget best. Time payments available.

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Manufacturing Company
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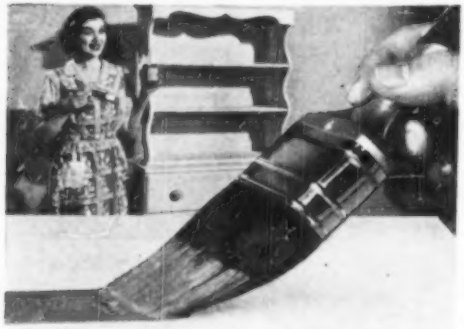
9-8A

POINTERS FOR HOME PAINTERS



How to get smoothest jobs ever with wonderful new NYLON paint brushes!

Dip only half the length of the bristles in paint—on overhead work dip to only one inch. Tap off the excess paint. Don't scrape off on edge of can.

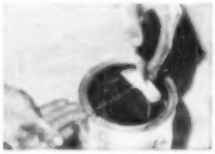
Nylon brushes hold a full load of paint. And they are ideal for nearly all finishes.

To get the best results, use a long, steady, even stroke, painting toward the surface already coated.

Durable nylon bristles don't break off and mar your work, and an independent research laboratory has found that nylon brushes paint smoother.

Use correct brush for each job. Poking large brushes into corners causes "fingering."

You can get a set of nylon brushes for every job, from touch-up work to wall and roof painting. They're made by leading manufacturers.



Clean thoroughly, suspend brush on wire in turpentine or linseed oil for storage between jobs. Resting bristles on bottom of can deforms them.

Nylon brushes clean quickly and easily. Work out paint on newspaper, clean with thinner, rinse with soap and water. Then comb the bristles and wrap the brush for storage.

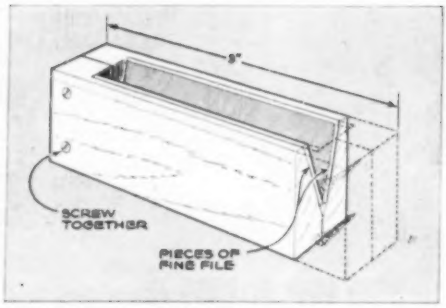
The next time you paint, try a smooth-painting, easy-to-clean nylon paint brush. You will never use any other kind. They're sold in paint, hardware and variety stores everywhere in all types and sizes.

DU PONT

Better Things for Better Living ... through Chemistry

NYLON PAINT BRUSHES

for smooth painting...easy cleanup



File Block Points Pencils

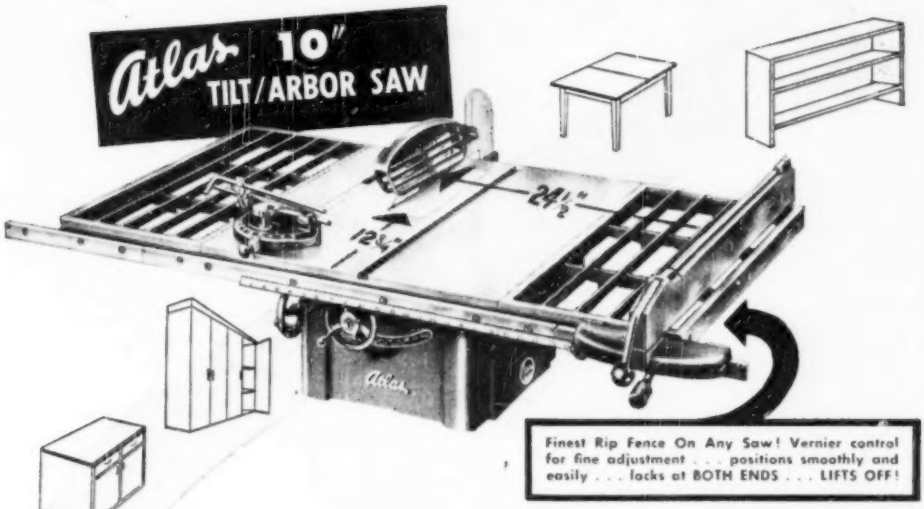
LIKE most draftsmen, I've tried many tricks and gadgets for putting a sharp point on my pencils. The best I have found so far is the pencil pointer shown here. I made it by breaking two pieces off a flat, fine-toothed file, and shaping two wooden holding blocks with a rasp. To use the pointer, I dip a pencil in the V-shaped opening and twirl it around.

Keeping a Chuck Key Safe

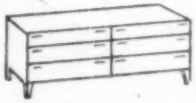
IF YOU have an electric drill with a geared chuck, tape the key firmly to the line cord, about four inches from the plug, as shown in the photo. Then you will not mislay the key. It is also a safety measure, because it is necessary to remove the plug from the receptacle to change drill bits, thus eliminating the possibility of accidentally starting the drill with the key engaged.—*Wm. Cowan, Mississippi City, Miss.*

It's BIG . . . It's HUSKY

Ready To Save You Hundreds of Dollars!

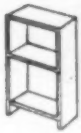


Finest Rip Fence On Any Saw! Vernier control for fine adjustment . . . positions smoothly and easily . . . locks at BOTH ENDS . . . LIFTS OFF!



You are equipped to handle *every* table sawing need *for a lifetime* with this big Atlas saw in your shop. It has the capacity to help you build a garage, utility buildings, a house . . . or to finish off a recreation room or attic. It has the accuracy for "factory-quality" work on fine cabinets and furniture and saves you money on shelves, cupboards, bookcases, and home repairs. You'll like every feature: The big *precision-ground grey-iron* table (25" x 45½" with extensions as shown) with its *super smooth surface;* the quiet smoothness of its *large sealed-for-life ball bearings;* the easy, accurate operation of the rip fence; the smooth-working blade height and angle controls. Blade cuts 3¼" deep — tilts to 45° — table is always flat. Yes — this Atlas is big, and rugged, and fast, and dependable—sure to make your shop and your work outstanding in the neighborhood. See it at your Atlas dealers today!

SEE Atlas 8" SAWS, TOO!



Same fine construction as the 10" saws.

FREE — *Woodworking Tool Catalog*

ATLAS PRESS CO., 1055 N. Pitcher St., Kalamazoo, Mich.

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Atlas — Atlas POWER KING

MATCHED PRECISION TOOLS FOR WOODWORKING AND METALWORKING

First Time Ever!

A COMPLETE CASCO electric POWER TOOL KIT

for only $9.95

14 PIECES INCLUDING THE FAMOUS CASCO POWER HEAD!

IT DRILLS, GRINDS, BUFFS, SHARPENS, SANDS, POLISHES, etc.

The most practical power workshop any craftsman or hobbyist can own! Absolutely an essential for Model Train Builders! All the accessories you need to work on metal, wood, glass, leather, plastic and fibre. 1001 year-round money-saving uses. Operates on AC and DC current. Fully GUARANTEED.

Now on sale at Department, Hardware, Appliance Auto Accessory and Jewelry Stores.

Write for Name of Nearest Dealer

FOR A SAFER 'LIGHT' AT NIGHT

CASCO VIS-O-LITE

Illuminated Automatic

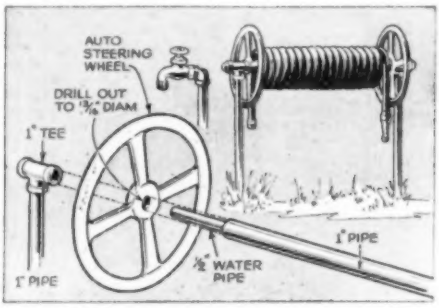
CIGARETTE LIGHTER

Why be without the convenience of this great new Vis-O-Lite illuminated lighter that makes driving safer day and night? You can replace your old lighter with a new Vis-O-Lite in a matter of minutes with pliers and screwdriver . . . and get the advantages of an illuminated lighter-well that ends fumbling in the dark, prevents scratching dashboards. Made by the manufacturers of the original pop-out lighter that's standard equipment on 4 out of 5 cars. Costs only **$2.75** complete. The illuminated well-assembly alone (minus the pop-out unit) costs only **$1.25.** Now on sale at Car Dealers, Auto Supply Stores and Service Stations.

CASCO PRODUCTS CORPORATION
BRIDGEPORT 2, CONNECTICUT
CASCO

Film Spools Find Shop Use

TAKE apart those small all-metal film spools of the type used in Kodak Bantam cameras and you have a tube with a notched end that cuts rapidly through wood when used like a drill bit. Besides making a neat hole, this improvised boring tool produces small wooden plugs that are ideal for concealing nail and screw heads or blemished spots in furniture. The two ends of a spool make metal washers.



Steering-Wheel Hose Reel

TO KEEP your garden hose coiled up when not in use and have it handy when needed, a reel made with junk-yard steering wheels will prove useful. The steering wheels are drilled out to 13/16" diameter to get a light press fit on a piece of ½" (nominal size) water pipe. Assemble with a shorter section of 1" pipe for a spacer between the wheels. The unit is mounted on legs formed by 1" tees and pipe driven into the ground near your outside water tap.

WAR-SURPLUS-BARGAINS!

ALL ITEMS BRAND NEW—UNCONDITIONALLY GUARANTEED

NEW! STATIONARY OR PORTABLE

D. C. ARC WELDER

250 AMPS. MODEL 252

FOR ANY WELDING JOB, LIGHT OR HEAVY

Stop Costly Repair Bills, Weld It Yourself and Save

(Item #65)

Only one or two jobs will pay for entire welder.

Designed for many years of trouble-free service. This precision engineered Direct Current ELECTRIC ARC WELDER is offered at but a fraction of its original value. It can be mounted permanently or easily transported for portable use. Does the job instantly where and when you need it. Has dial type rheostat for easy pinpoint control and a high-low range switch. Run welder at 2500 RPM from drive pulley or power take-off of tractor, a 7½ HP electric motor or a 10 HP gas engine. Use two V belts or flat belt (on pulley).
Now . . . AT A FRACTION OF ITS VALUE. Price includes double V or flat belt pulley and instruction book. Shpg. wt. 107 lbs. **F.O.B. Chicago** **99.50**

ACCESSORY KIT including welding helmet, electrode holder, two 10 ft. cables with clamp and 5 lbs. of assorted welding rods. **(ITEM #66)** ....Shpg. wt. 17 lbs. **F.O.B. Chicago** **10.50**

If more information is desired write for welder circular.

SURPLUS SPECIAL!

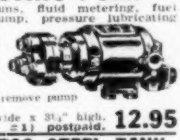
CONTINENTAL RED SEAL 1½ H.P. ENGINE

(Item #97)

1 cylinder, 4 cycle gas engine with 6:1 gear reducer for 300 to 400 RPM output. ● For Lawn Mowers, Garden Tractors, Light Farm machinery, Feed Mills. ● To drive Pumps, Compressors, Generators. Engine rated 1800 to 2400 RPM. Complete with starter rope, muffler, oil bath air cleaner. Shpg. wt. 60 lbs. A $74.00 VALUE. NOW . . . WHILE THEY LAST.......... (F.O.B. Chicago) **39.50**

SELF-PRIMING ELECTRIC PUMP

APPLICATIONS: Oil burners, aquariums, fluid metering, fuel pump, tool post grinder, coolant pump, pressure lubricating pump, general industrial, etc.



Motor Mfd. by Black & Decker: Double ball bearing series wound, continuous duty 1/30 H.P. electric motor, rated 12,000 R.P.M. Transformer included for use on 110 V AC current. Also applicable for 24-32 V DC. **Pump Mfd. by Weldon Tool Co.** with standard ¼" tubing ports: rated 2 G.P.H.; remove pump and use motor as high speed grinder.
Overall Dimensions: 7¾" long x 3¼" wide x 3¼" high. Approx. wt. 5 lbs. $51.00 value **(Item #1) postpaid.** **12.95**

G-I STAINLESS STEEL TANK

(ITEM #63)

Use these tanks on compressors, for tire inflators, pulsation chambers, floats, buoys, hydraulic reservoirs, fluid and milk containers, fuel containers, etc. Tough, light, shatterproof. 450 P.S.I. Aviator's Breathing Oxygen bottles, type G-1, 2100 cu. in. (approx. 9 gallons) int. vol. 24"x12". ½" threaded openings at ea. end. Wt. 19 lbs. F.O.B. Chgo. **5.95**

HYDRAULIC CYLINDERS—Air or Oil

Large supply of new labor-saving, economical hydraulic equipment in many types and sizes. Use these positive, highly efficient, smooth pressure hydraulics on presses, arbors, lifts, loaders, power control, positioning, brakes, plastic dies, auto frame alignment, etc., etc.

(Item #42)

ITEM #4—All steel double action hydraulic cylinder, 1⅛" bore, 2⅞" stroke. Clevis mounting. Will lift 1000 lbs. with 1000 P.S.I. line pressure. Perfect for positioning and feeding movements. Shpg. wt. 4 lbs. **F.O.B. Chicago** **4.95**

ITEM #33C—Double action hydraulic cylinder, 1½" bore, 4½" stroke. Clevis mountings at both ends. Uses ¼" pipe fittings.......... **Postpaid** **8.95**

ITEM #32—Double action, 1½" bore, 9" stroke, will lift 1760 lbs. with 1000 P.S.I. line pressure. Wt. 4 lbs. A $15.00 value **Postpaid** **10.95**

ITEM #41—Double action hydraulic cylinder, 2" bore, 6" stroke, clevis mounting at base and end of shaft. Overall length closed 12½". Has ⅝" stainless steel shaft, uses ¼" tubing fittings. Will lift up to 3100 lbs. with 1000 P.S.I. line pressure. Weight 7 lbs. **Postpaid** **12.50**

ITEM #16—Double acting cylinder, 1½" bore, 27" stroke. (Will lift 1760 lbs. with 1000 P.S.I. line pressure. Wt. 8 lbs. A $55.00 hydraulic cylinder value for only **Postpaid** **12.95**

ITEM #15—Double acting cylinder, 3" bore, 10½" stroke. All steel hydraulic cylinder will lift up to 7000 lbs. with 1000 P.S.I. line pressure. Wt. 12 lbs. A $78.00 value. **Postpaid** **19.50**

Item #40 Double action, 3½" bore, 20" stroke. Rated lift capacity 9600 lbs. with 1000 P.S.I. line pressure. Clevis mounting, aluminum alloy barrel with 1½" stainless steel shaft and piston. Wt. 20 lbs. A $125.00 value. **F.O.B. Chicago** **25.00**

ITEM #6-A—Double action hydraulic cylinder, 3" bore, 25" stroke, will lift 7070 lbs. with 1000 PSI line pressure. Steel barrel, 1⅛" stainless steel shaft. Gov't acq. cost $176.00. Shpg. wt. 26 lbs. **F.O.B. Chicago** **28.00**

ITEM #42—Double action hydraulic cylinder, 4" bore, 18" stroke. Rated lift capacity with 1000 P.S.I. line pressure is 12,500 lbs. Ship wt. 30 lbs. **F.O.B. Chicago.** An Excellent Buy for **32.50**

HI-PRESSURE FITTINGS for cylinders and valves available at 50c ea. for ⅜" pipe and 65c ea. for ½" pipe.

FREE: 44-PAGE CATALOG—WRITE TODAY!

Brand New

AUXILIARY ELECTRIC AC GENERATING PLANT

For General Utility and Emergency Use

(ITEM #88)

2500 watts ● 115 volts A.C. 60 cycles

Plenty of current to operate your: Oil Burner, Sump Pump, Refrigerator, Home Freezer, Power Saw, Lights, Radio and Television, Home Water System Pumps.

Complete integrated heavy duty electric power plant, Signal Corps Model PE-75, driven by Briggs & Stratton, one cylinder 6½ H.P. Model ZZ, 4-cycle engine with killer button, oil bath air cleaner, governor, muffler, starting rope, and radio interference filter. The self-excited Leland or Westinghouse generator is rated 2500 Watts, 115 Volts, 60 cycle A.C. single phase, belt driven, with guard and duplex receptacle. When generator is not in use, you can use the engine separately to power other equipment. Mounted on adjustable steel skids, notched for carrying poles. Net wt. 310 lbs. Shpg. wt. 440 lbs. Dimen. 36" x 19½" x 24". 12 month guarantee. $725.00 value. **NOW** .... **295.00** F.O.B. Chgo.

UTILITY PUMP ROTARY VANE TYPE

Perfect For Water, Oil or Insecticides

(Item #51)

Sprays DDT, 2-4D, sulphur compounds, etc. Pressures to 150 lbs., 15 gals. per min. at 1200 RPM using 2 HP. As vacuum pump for milking machines, lab use, etc., delivers 26" vacuum, 4.5 cu. ft. per min. at 1500 RPM, using ¾ H.P. Rotate either direction. ½" pipe thread ports, ½" standard shaft, 4 ball bearings. Easy to mount—Ready to run. Shpg. wt. 13 lbs. F.O.B. Chicago.......... **16.50**

DIRECT CURRENT GENERATORS

For welders, plating, truck and marine use, D.C. appliances, lights, etc. Aircraft quality—lifetime grease sealed ball bearings. Heavy duty.

Item #89—Type M-2, rated 50 Amps.—24 Volts. Mfd. by Leece-Neville Co. Shpg. wt. 32 lbs. Gov't. Acq. Cost $176.00 **F.O.B. Chicago** **NOW ONLY** **16.50**

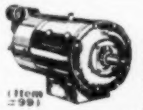
Item #90—Type P-1, rated 200 Amps.—28 Volts, 2500 RPM. Mfd. by General Electric, Ford, Delco-Remy and Westinghouse. Gov't Acq. Cost $300.00, Shpg. wt. 70 lbs. **F.O.B. Chicago** **22.50**

Item #91—Type R-1, rated 300 Amps.—30 Volts. Mfd. by Jack & Heintz. Gov't Acq. Cost $380.00, Shpg. wt. 70 lbs. **F.O.B. Chicago**.......... **35.00**

Each individually packed in wooden box.

D. C. GENERATOR

For 12 Volt Systems



(Item #99)

BRAND NEW. Rated 15 Volts at 50 Amps. Use on 12 Volt circuits on trucks, tractors, ships, planes, battery chargers, auxiliary lights, etc. Base mounting with 4 bolt holes. ⅝" threaded shaft with keyway. Mfd. by **Bendix-Eclipse.** Gov't. acq. cost $106.00. Shpg. wt. 33 lbs. **F.O.B. Chicago** **21.50**

LOGAN HEAVY DUTY

HYDRAULIC PUMP

(Item #29)

For operating hydraulic cylinders and hydraulic motors on tractors, bulldozers, construction machinery, lift trucks, industrial applications, etc. Delivers 10 GPM at 1200 RPM at 1000 P.S.I. using 6 HP. Has ¾" inlet, ½" outlet, ¾" shaft with flat and keyway for direct or pulley drive. Has flange with 4 bolt holes for convenient mounting. Sh[illegible] wt. 22 lbs. Overall dimen.: 7" L x 5½" [illegible] x 5½" W. A $105.00 value FOR ONLY .... **F.O.B. Chicago** **22.50**

VICKERS HYDRAULIC TRANSMISSION

MODEL AA16801A Ideal for lathe drive, miniature cars, power machinery, gearing, etc. Rated 2 HP maximum input at 3750 R.P.M. Output speed continuously variable from 0 to ⅓ of input speed in either direction. Self contained reservoir. All controls external. Even power at all speeds. Complete with two ½" shafts with flat for pulley attachment. Shpg. wt. 20 lbs. Gov't. acquisition cost $325.00. A tremendous value at **25.00**
(ITEM #85) (F.O.B. Chgo.)

HYDRAULIC CONTROL VALVES

(ITEM #24)

ITEM #24. Four-way control valve with built-in relief valve, for use with one double action hydraulic cylinder. May be used with 1500 P.S.I. hydraulic system to open and close hydraulic cylinders. Ship. wt. 8 lbs. A $38 value. **postpaid** **7.95**

ITEM #26. Four-way control valve for use with two hydraulic double-action cylinders. Each cylinder may be operated independently of the other or in conjunction with the other. Oil may be locked in any of the cylinders to hold the piston at any required position. Ship. wt. 6 lbs. A $60 value. **postpaid** **10.95**

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The Safe Saw that Cuts One Inch Wood 50% Faster and with 70% Less Noise!

Ideal for Dad's workshop—*safe* for children! Largest, most powerful of its kind! Quiet operation. Cuts any length 1" wood, thin metal, plastic. Portable. 14,000 Safety Strokes a minute. ***Entire*** Saw approved by Underwriters' Laboratories, Inc. Power Unit **GUARANTEED *against burn-out all during your ownership.***

Complete with Built-In Motor, $17.50.

SYNCRO ELECTRIC JIG SAW

No. 401 $12.50

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SYNCRO's stone-that-moves-240-strokes-a-second enables you to hone SHARP almost anything—tools, knives—easier and in your favorite honing style! Safe to use. With Built In Motor, 1 Stones— $12.50

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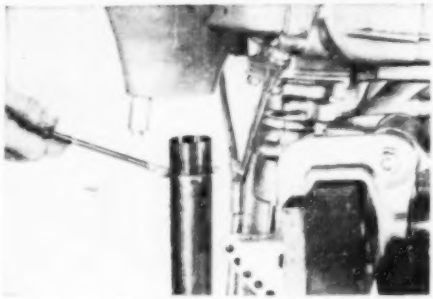
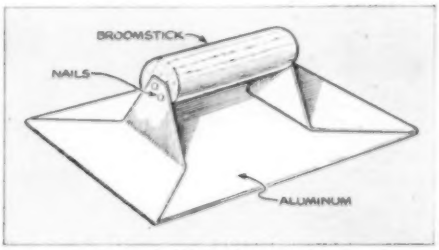
Operate on 60 cycle, 110-120 volt, AC only. Buy at dealers. If none near, send article price, we'll ship POSTPAID. (Dealers write for information.)

SYNCRO CORPORATION
Dept. G-100A, Oxford, Michigan, U.S.A.

Collar Protects Exhaust Pipe



On some outboard motors, the exhaust pipe becomes coated as the result of oil and carbon running down onto it and baking there. Often this gets smeared on your clothes or hands when you lift the motor on or off. A brass or stainless-steel collar silver-soldered or brazed to the exhaust pipe ¾" below the muffler will stop this condition. With a light hammer, cup the collar upward except at the point being touched with the screwdriver in the photo. Slope the collar downward slightly at this point to drain away any seepage from the muffler.—*Clinton R. Hull, Costa Mesa, Calif.*



Trowel for Small Repair Jobs

A simple trowel for small cement or plastering jobs can be made from 18- or 20-gauge galvanized iron or half-hard aluminum. Cut a 4" by 16" strip of the metal and bend it to the shape shown in the sketch. Use a 4" piece of broomstick for the handle, nailing it in place.—*C. Kenneth Pearse, Tucson, Ariz.*

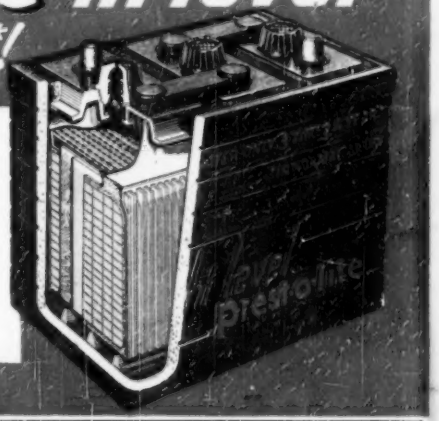
Windshield Can Be Scratched

Don't let a gas-pump attendant wipe your windshield with a dry cloth. This may leave minute scratches on the glass. For the same reason never operate the wipers to remove dirt on a dry windshield.

Hi-level needs water only 3 times a year! In Normal Car Use

Prest-o-lite *hi-level*

70% longer average life!*



AVOID battery failures, get longer battery life, with the new Prest-O-Lite Hi-Level Battery that needs water only 3 times a year in normal car use. Helps prevent a major cause of battery failure. In addition, Hi-Level gives you Fibreglass mats to keep power-producing material in the plates for longer life. Make your next battery a Prest-O-Lite Hi-Level.

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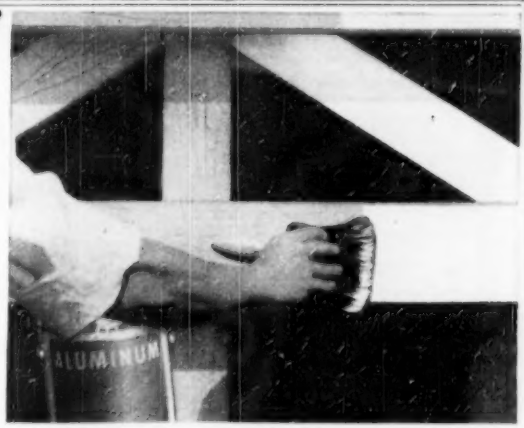
FREE BOOK TELLS HOW

New free 24-page illustrated booklet tells how you can add years of life to fences, trellises, all weather-exposed wood—with a coat of the *right* aluminum paint. Oil-rich Aluminum *House Paint* seals out moisture, says NO to wood deterioration. Dozens of helpful painting tips like this—secrets of master painters—in this free booklet. Send for your copy today! And be sure to get the brand that bears the Alcoa symbol of quality when you buy aluminum paint from your dealer.



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Stop searching, get a 32 or 64 drawer Jiffy to keep those small items that usually get mislaid. Spot welded steel, gray enamel finish, metal drawer guides. Dividers included with aluminum drawers make possible three compartments per drawer. Looks good anywhere. Send check or money order, please—no C. O. D.'s. Prices below. Your more refunded if not satisfied. Dealers write for quantity discount.

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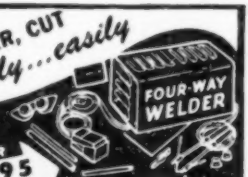
WELD BRAZE, SOLDER, CUT quickly...easily



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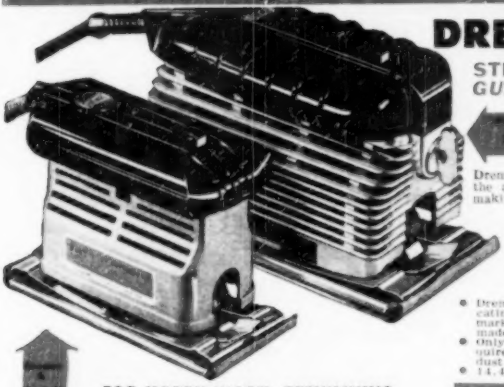
PRACTICALLY DESIGNED . . . EASILY OPERATED . . . QUALITY BUILT . . . FULLY GUARANTEED



DREMEL *Electric* SANDERS

STRAIGHT-LINE RECIPROCATING ACTION
GUARANTEES SCRATCH-FREE SURFACES

FOR HEAVY-DUTY CRAFT AND WOODWORKING PROJECTS

Dremel's new Model 2000 is a fast-cutting, production sander. It has the added stroke and extra power required for furniture and cabinet making, boat building or refinishing. Great for building operations, sanding woodwork, dry wall joints, siding and other surfaces. Does a superb wax polishing job, too. Weighs only 5 pounds yet has 21 sq. in. sanding surface (bar-all size 3¼" x 1½" x 7"). Complete with steel carrying case, 2½ sq. ft. sheets sandpaper, polishing pad..... **$24.50**

LOOK FOR THESE DREMEL FEATURES

(In Model A and Model 2000 Sanders)

- Dremel's Straight-Line Reciprocating Action leaves no sanding marks . . . removes scratches made by other type sanders.
- Only two moving parts . . . requires no oiling . . . sanding dust does not affect action.
- 14,400 cutting strokes per minute assure faster sanding-polishing.
- Cam-type holder permits changing paper in seconds.
- 8 ft. Underwriter's approved cord . . . operates on 110-120 volt, 60 cycle A.C. . . . . fully guaranteed.

FOR HOBBY WORK, REFINISHING AND REDECORATING . . .

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THE POCKET-SIZE MACHINE SHOP

Don't confuse Moto-Tools and Accessories with so-called "bargain offers." Compare Dremel feature for feature with competitive tools. If our products are not superior in every way, we don't want you to buy.

MOTO-TOOL KIT NO. 2 With 25 Accessories (High Speed Steel Cutters, Grinding Wheels) **$23.50.**
MOTO-TOOL NO. 2 (only) with one emery wheel point **-$16.50.**

Moto-Tool is the most versatile tool you can own—grinds, routs, drills, carves, engraves, polishes, etc. **Look at these features:** Approx. 27,000 R.P.M. ● Dynamically balanced armature eliminates vibration. Oilless (oil-sealed) bearings ● Dust-filtered air-cooling system ● Weighs 13 oz. ● Uses 110-120 v. AC ● Used in plants of General Electric, Ford, Remington Arms, Nash-Kelvinator, etc.

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Only $9.95
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SAFE! AS A HANDSAW

For home, hobby, repair work—no other tool pleases so much for so little cost. Works in any direction—delivers 7,200! strokes per minute—smoothly, effortlessly. Saws through ¾" medium-hard wood at a foot-a-minute speed. Touch-of-the-trigger, foolproof action. Only 2 moving parts, never needs oiling. Uses 110-120 v. A.C.

Use for 6 useful projects packed with each saw

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Dremel Tools are sold everywhere. If your dealer cannot supply you, send remittance in full and we will ship postpaid. Or send only $2 and pay postman balance plus postage and fee. **Money back if not delighted after 5 days' trial.**

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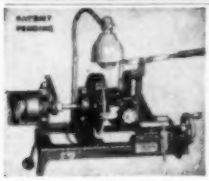

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SHARPEN DULL PIPE WRENCHES
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PALMGREN ROTARY, INDEX, MILLING TABLE

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"Try these slick tricks with
PLASTIC WOOD"

Fill cracks in chairs—

Makes loose joints firm, sands to a smooth finish!

Reset loose hinges—

Replaces rotted wood, tightens loose screws . . . *easy* to apply!

Repairs broken toys—

Mend cracks, nicks! Smooth finish!

Also useful in filling cracks in floors, nail and screw holes, repairing loose tiles. *Handles like putty . . . hardens into wood!*

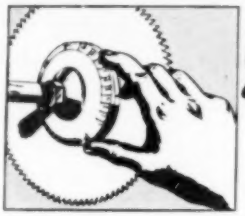
PLASTIC WOOD®

A CELLULOSE FIBRE FILLER

IN CANS OR TUBES

DOZENS OF OTHER USES

Better, Easier, Quicker
GROOVE CUTTING or CABINET-MAKING
with *Warren* DADO SAWING WASHERS



Just dial
DESIRED CUT

Cut accurate, parallel grooves—any width, any angle. Just dial desired width with Micromatic adjustment. Cuts smooth and clean—no burning or chewing to mar fine wood. Just four simple washers. Available in 5 sizes—½", ¾", ⅝", 1", 1⅛". Free booklet on request. See your dealer or write direct. Absolutely guaranteed! In Canada, send money order for $4.95 (duty and sales tax extra).

$4.95 A SET

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BRAND NEW SURPLUS BARGAINS

Continental
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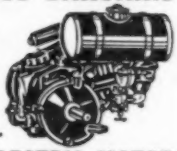

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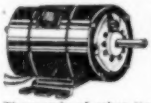
Add $1.00 for shipping charges



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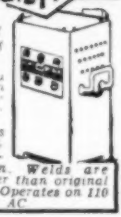

All parts Ready-Made and easy to assemble. You can do all around welding on steel, cast iron and other metals after only a few hours practice. Illustrated instruction manual included. Sold on 30 Day Money-Back Guarantee

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Gives 100% penetration. Welds are stronger than original metal. Operates on 110 or 220 AC

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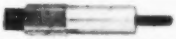
for ALL electric drill accessories—ORDER TODAY!

NEW BULL "200" 1/4" ELECTRIC DRILL

only **$14.95**

A PORTABLE POWERHOUSE!—WE GUARANTEE YOUR MONEY BACK if it isn't more powerful than any 1/4" electric drill at ANY price!



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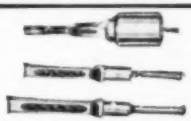
for any electric drill, drill press or flexible shaft. When ordering, specify standard or Phillips head **$4.95**

NEW PORTABLE BELT SANDER

Fits any 1/4" elec. drill; does every job from roughing to finishing. Complete with 3 pressure pads and 2 sanding belts... **$19.95**

BULL BUFFER

complete with sheepskin bonnet, rubber pad, 2 sanding discs **$9.95**



PORTABLE BULL MORTISING KIT

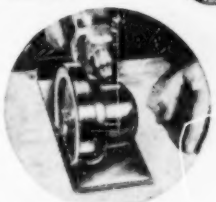
For on-the-job mortising with elec. drill or drill press. Complete with adapter and 1/4", 3/8" and 1/2" chisels and corresponding bits **$23.90**

BULL MORTISING ADAPTER

Fits any 1/4" elec. drill and any standard shank chisel. (Bit and chisel prices on request). Only **$6.95**

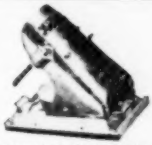
BULL MANDREL KIT

Includes mandrel, 2 1/2" grindstone, 1" wire brush, 4" cloth buffing wheel **$2.19**



NEW BULL SAW

Fits any 1/4" electric drill. Powerful, portable, easy one-hand operation. Complete with saw blade **$9.95**



BULL HIGH SPEED JITTER SANDER

For 1/4" drill. Makes perfect, flawless finishes; one-hand operation **$9.95**

4-IN-1 HOLE SAW!

For any 1/4" electric drill or drill press. Complete with arbor and 1", 1 1/2", 2" & 2 1/2" blades **$4.95**

Send 10c for catalog of other new drill accessories

At your dealer or send cash, check or M.O. for immediate, propaid shipment.

BERTRUM B. ENGINEERING & SUPPLY CO.

3121 MAIN STREET **KANSAS CITY, MO.**

WORK-SAVERS OF THE WORKSHOP-"ARCO" QUALITY TOOLS

AT BETTER HARDWARE STORES EVERYWHERE

EVERY ELECTRIC DRILL A PORTABLE SAW

'ARCO SAW'

9.95 compl. with 4" "HYCARBON" Crosscut Blade

CAN BE USED WITH ONE HAND

Any 1/4" or 3/8" Drill a Powerful Saw in ONE MINUTE

"ARCO-SAW" is a rugged tool with **right angle gear drive** (no clumsy, dangerous, direct drive with drill sideways). Works like a high priced Portable Saw.

Only ARCO Gives You All These Features: Safety-yoke assures rigid connection and **absolute safety—Big handle** affords firm grip for two-hand operation—**Precision one-piece** gear box—**Self-lubricating** lifetime bearings—**Wide shoe-plate** for straight, square cuts—Lowest priced, quality Replacement Blades.

90-DAY FACTORY GUARANTEE

"HYCARBON" Crosscut Blade	$1.60
"HYCARBON" Combination Blade	$1.60

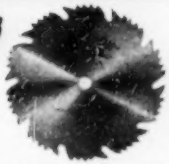
NOW! EVERY "ARCO-SAW" AN ANGLE SANDER & POLISHER

Your "ARCO-SAW" becomes a powerful **right angle** sander & polisher in just a few minutes. Ideal for removing paint from cars & walls, simonizing cars, polishing linoleum & furniture. **Swivel action** between drill chuck & gear box permits new freedom of use at any angle on every surface, or when necessary safety-yoke can be used to hold unit rigid. No need to buy an expensive special angle gear drive. New ARCO "SAND-'N-POLISH" Attachment consists of flexible molded rubber head, sanding disc, lambswool polisher, bottom plate, hexagon adaptor, & also 1/4" adaptor for use in drill chuck.

$1.95

BETTER BLADES AT LESS

ARCO "HYCARBON" SAW BLADES



Made of finest, heavy gauge, TEMPERED TOOL STEEL, HANDFILED.

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For top-notch quality and performance you can rely on these famous precision-made ARCO "HYCARBON" CIRCULAR SAW BLADES. Designed especially for long and rugged use, they cut cleaner and faster.

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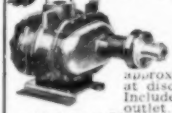

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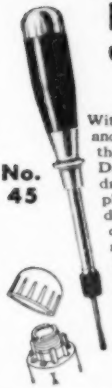

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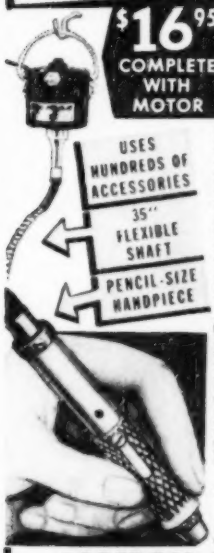

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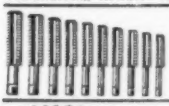

Set 15E 10 Different Size High Speed Standard Thread Hand Taps up to 7/8". Priced at only **$2.49**

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Set 16E 4 High Speed Milling Cutters. Set consists of 2 side milling cutters, sizes 3 x 1/8 x 5/8" arbor and 2 x 3/16 x 5/8" arbor; 1 plain milling cutter 1 1/4 x 1/2 x 5/8" arbor; and 1 corner milling cutter 2 1/4 x 1/8" arbor; and 1 corner milling cutter 2 1/4 x 5/8" arbor to cut 1/4" radius. Set of four priced at only **$4.95**

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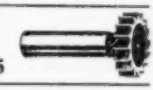

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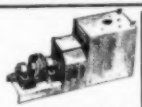

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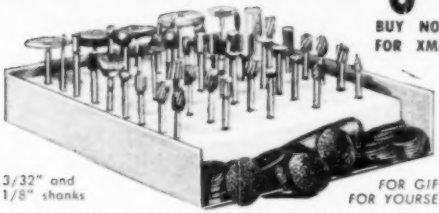

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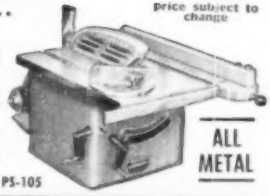

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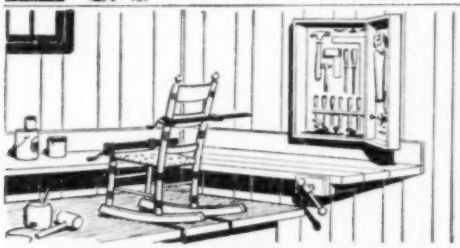

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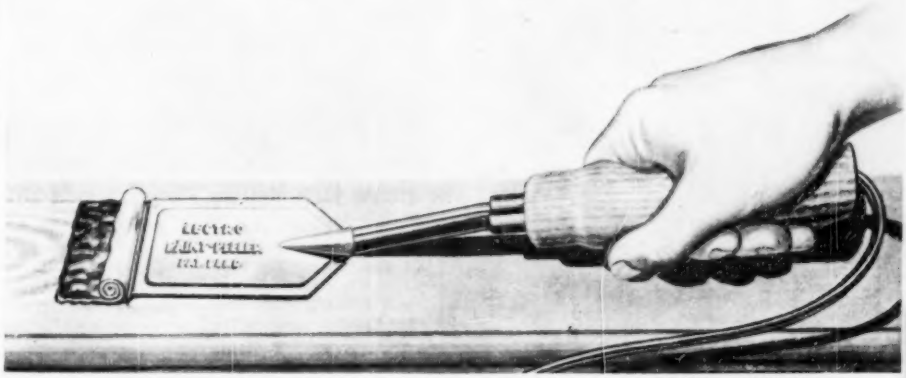

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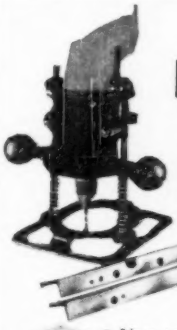

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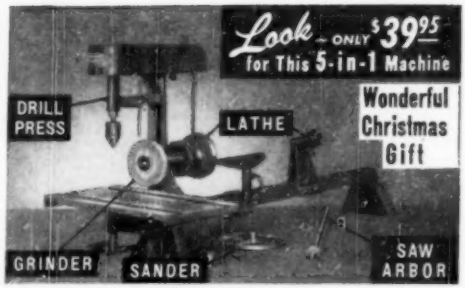

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Two simple adjustments. Gets hollow-ground, cross-cut or combination saw blades true and sharp. Fits 6" to 12" blades ½" to 13/16" centers. Includes file, complete instructions. $6.95 postpaid. (C.O.D. postage extra.) Guaranteed—Money back if not satisfied after 10 day trial. **Soon pays for itself.** Order today. Free folder.

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WITH *Infinitely VARIABLE SPEEDS, Clutch and INSTANT REVERSE*

OUTPUT TORQUE ADJUSTMENT UP TO 180 inch POUNDS

This positive displacement Hydraulic Torque Converter is the ideal fluid drive with thousands of uses. Output Speeds Infinite 0 to 550 R.P.M. in either direction. Change Speeds WHILE RUNNING. Control and Transmit your power this SMOOTH OILWAY. Will handle ¼ H.P. to 1½ H.P. Motor. Industrial or Home & Farm Use. Cost Government $300. High Quality Precision Workmanship. Buy this unit to get the most for your money. Case measures 7½" long 7" high 6½" wide. Input & Output Shafts ⅝" dia. Beautiful Red Crackle Finish Case.

FINGER TIP CONTROL

Shipping Wght. 25 pounds

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Prepaid in U.S.A.

2 quarts oil included FREE

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1½"-8 thread Lathe Chuck Adapter, $3 extra

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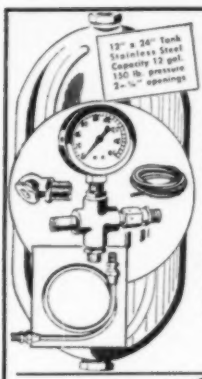
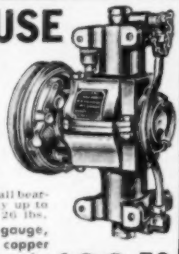


WESTINGHOUSE Air Compressor



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Model T-1 Brand New — 2 CYLINDER PISTON TYPE **$21.50**

Operates with ½ H.P. Motor or equivalent gas engine.

Compressor has 2" bore, 1½" stroke, ball bearing, 3.27 CFM at 600 R.P.M. Capacity up to 6.54 CFM. Size 9"x11⅞"x6⅞". Wt. 26 lbs.

Compressor, pressure tank, air gauge, air chuck, 20-ft. hose, pop valve, copper tubing with 4 brass flared fittings for connecting compressor to tank, 4-way cross and 3 nipples.

COMPLETE OUTFIT, wt. 52 lbs. **$32.50**

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COMPRESSOR SEPARATELY, $21.50
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"Wellworth" BLOWER

at a Bargain Price

Quiet operating. Double wheel inlet, double width blower. For heating, ventilating, cooling, air washing, exhausting and forced draft. DIMENSIONS: 10" wheel; outlet 13⅛" x 11⅜"; inlet 8¾". Height 19". Width 18". Depth 16½". C.F.M. ¼" S.P. 1600; outlet vel. 1575; motor ¼ H.P. with overload relay; cord & plug, 110 v. 60 cy. AC. Ship. Wt. 67 lbs. Bargain price..... **$39.50**

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For Air or Water

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75 to 100 lbs..... **7.50**
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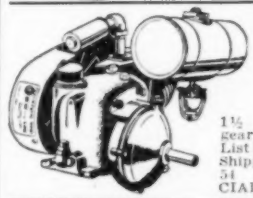
¼" check valve..... **2.75**
¼" regulator and gauge..... **5.75**



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6 to 1 Reduction Gear

1½ HP with 6 to 1 reduction gear. Operates at 450 R. P. M. List Price $79.50 Shipping weight 54 lbs. SPECIAL PRICE.... **$39.50**

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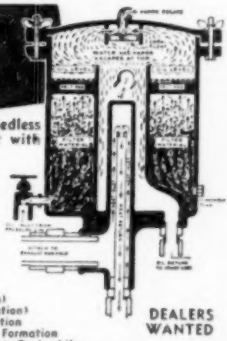

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Illuminated Chrome Plated

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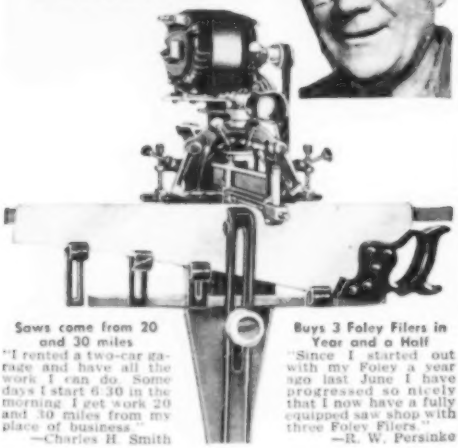

Saws come from 20 and 30 miles

"I rented a two-car garage and have all the work I can do. Some days I start 6.30 in the morning. I get work 20 and 30 miles from my place of business."
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"Since I started out with my Foley a year ago last June I have progressed so nicely that I now have a fully equipped saw shop with three Foley Filers."
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FOLEY FILED SAWS BRING NEW CUSTOMERS

Here is a steady repeat CASH business you can start in your own basement or garage in your spare time. Every saw you sharpen with the machine accuracy of the Foley Saw Filer is an ad that brings more customers. S. M. Hollingshead wrote to us: "I am doing very well with my Foley Filer, and I am glad I invested in your machinery. It is very satisfactory and works very well in the small community in which I live."

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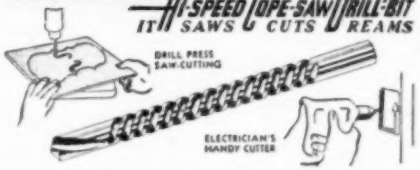
HI-SPEED ROPE-SAW DRILL-BIT

IT SAWS & CUTS & REAMS



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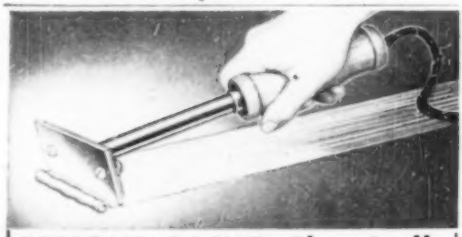

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Rust resistant alloyed steel, extra flexible, preformed – 7 x 19 strand-on reels.

1/16"	3½ ft.	7/32"	7½ ft.
5/64"	4¢ ft.	1/4"	9¢ ft.
3/32"	4½¢ ft.	9/32"	10¢ ft.
1/8"	5¢ ft.	5/16"	12¢ ft.
5/32"	5½¢ ft.	3/8"	13¢ ft.
3/16"	6½¢ ft.	1/2"	16¢ ft.

Stainless Steel Cable

1/16"	5¢ ft.	1/8"	14¢ ft.
		1/4"	24¢ ft.

PIANO HINGE

Overall Width	Length	Price Ea.
1/4" (5/8" side)	72" alum.	$1.00
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CTU-2 Foote linear actuator. 24 Volt A.C. or D.C. 8500 R.P.M., 1/6 H.P. Series wound motor, 4½" stroke in 13½ seconds. Compression and tension Loads up to 750 lbs. Adjustable micro switch for limits of travel. Overall length retracted 11" **Only 6.95**

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DUNMORE ELECTRIC MOTOR. Adaptable to rigid or flex drive, 400 R.P.M. at power take-off. Contains 1/25 H.P. 24 volt, 7½ amp reversible motor for indicating position. Has limit switches, magnetic brake, resistor to coordinate instrument. Overall dimensions 6½" x 4½" long. **ONLY** **7.50**

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Heavy Duty G.E. Gear Head Motor. 1½ H.P., 24 volt DC, 125 amp reversible motor will drive reduction gear box unit 44.5 to 1, resulting in 168 R.P.M. at 5.8" diameter take-off shaft. Motor contains electro magnetic break.

UNIT COMPLETE 10.95 MOTOR 4.95

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We also have transformers for above.

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6 to 1 with screw shaft #111 . . . . . **$4.98**
85 to 1 (can be used for radio antennae, etc.) **$3.95**

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VTG-2 – Inline spur gear 16 to 1 reduction, thru 4 gears. Final take-off 4½" dia 26 tooth, ½" Alum. spur gear . . **$6.49**

Both above gear boxes have lever control for engaging & disengaging positive clutch. Dust proof housing. Prelubricated bearings. Both can be adapted to Vickers Transmission.

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City_____ Zone____ State____

New

Self-Pressure Torch. This torch—introduced by Turner Brass Works, Sycamore, Ill.—does not need a pump. A brass wire, interwoven with the wick, conducts heat from the burner to the tank to produce pressure. It's available in models for gasoline and alcohol. The 7½ oz. of fuel it holds will burn at 1,700° for 3½ hours.

Drill Press. A feature of this latest tool from the South Bend Lathe Works, South Bend, Ind., is the automatic belt-tension unit. It maintains proper tension and the spring helps to absorb shock if the drill catches in the work. The floor model of the 14", 156-lb. tool—pictured at right—is priced at about $87; a bench model sells for about $75. Both prices are less motor. The 10" by 10" table has a ¾" thick edge all around for clamping work. A ¼- or ½-hp. motor is recommended.

Tools

Drills at All Angles. With this all-angle head for ½" electric drills, you can work in tight spots that you couldn't get to ordinarily. For instance, joists set on 12" centers can easily be drilled at any angle with the head attached to your drill. Cummins Portable Tools, a division of Cummins Business Machines Corp., Chicago, makes the attachment. The 2-lb. head can be detached quickly and it fits most ½" drills. Gear ratio is 2 to 1. The tool measures 7½" wide when the drill is set at right angles.

Pliers Have Pistol Grip. Hard-to-get-at jobs are easier to reach with these pistol-grip, slip-joint pliers made by the Utica Drop Forge & Tool Corporation, of Utica, N.Y. They sell for $2.20. The tool fits the natural hand grip and normal pull on the handles tightens the grip on the work, giving more holding and pulling power.

THE SAME NAME...

Starrett

Your Guide To Greater Value In

HACKSAWS AND BAND SAWS

Hacksaws and band saws bearing the name "Starrett" must uphold the Starrett reputation for reliability. To insure top performance with easy cutting and maximum economy, insist on blades and bands precision made by the "World's Greatest Toolmakers."

HACKSAWS For Hand or Power Cutting

All types, all sizes, for hand frames and hacksaw machines. Every blade milled, heat treated, tested and inspected to meet Starrett standards of quality.

BAND SAWS For Metal, Wood, Plastics

Hard-edge flexible-back, spring temper and "Skip-Tooth" types for all precision cutting. Cut to length and welded, or as coil stock in handy reel dispenser.

Get This MECHANIC'S HAT — Only 15¢

Wear an official Starrett hat — the badge of a precision craftsman — on the job, in your home shop, working around the car, etc. Send 15¢ in coin to cover handling and mailing. Please specify head size. Address Dept. P5

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Since 1880 . . . Standard of Precision

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Buy Through Your Distributor

BUILD YOUR OWN TILTING ARBOR SAW!

SAVE $50 OR MORE

Exclusive GIL-BILT Build-It-Yourself Features

- No machining—build easily with hand tools only
- No blueprint reading—step-by-step pictorial plans, full scale patterns, actual photographs
- Sturdy wood, aluminum, and steel construction
- Capacity and performance of commercial saws selling for $80 and up

GIL-BILT 10-INCH TILTING ARBOR SAW

- 27x28 in. table, 13½ in. capacity in front of blade
- 10 in. blade cuts 3¼ in. deep, tilts full 45 degrees
- Floor model 34" high table always stays level
- New Departure ball bearing arbor, ¾" precision shaft turned down for ⅝" bore blades, alum. housing, shipped ready to run
- Jackscrew and 4½ in. dia. handwheel lowers and raises blade
- Cast aluminum miter gauge and self-aligning rip fence guide

GIL-BILT Metal Parts Kit includes Plans, ball bearing arbor, miter gauge and bar, rip fence guide, dado insert, lock knobs, jackscrew mechanism and handwheel, and all other metal parts (less blade) $20.95
Same Kit with 10" Combination Blade $24.90
Same Kit with 8" Combination Blade $23.90

GIL-BILT 12-INCH BAND SAW

- Cuts to center of 24 inch circle
- Handles stock up to 6 inch thick
- 18x18 inch table tilts 45 degrees
- Lower wheel and drive pulley runs on sealed New Departure Ball Bearings; Upper wheel runs on two ⅝" bore Glilite Bronze bearings
- Upper wheel tension and tilt mechanism of cast aluminum, completely assembled
  - Upper and lower blade guides. Each has ball thrust bearing, self-lub bronze jaws.
  - Rubber tired wheels. Choice of cast aluminum or make-your-own wood wheels on metal hubs
- Uses standard 78 inch blades up to ⅝ inch wide
- Fully enclosed mechanism for utmost safety

GIL-BILT Metal Parts Kit includes Plans, rubber tires, ¼ inch blade, hubs for wood wheels, ball bearing spindle, tilt mechanism, guides, table tilt segments, and all other metal parts $16.95
Same Kit with two machined ready-to-install 12" cast aluminum wheels $20.95

Return Kits in 10 days for refund if not satisfied.
(Prices include postage within 600 miles. Over 600 add 2%)

Also available—Plans and Parts Kit for 8" Tilt Table saw. Order Plans at $1.00 each—sent postpaid anywhere in the world or write for FREE descriptive catalog.

GILLIOM POWER TOOLS P. O. Box 1-VK, Lambert Field St. Louis 21, Missouri

VERSATILE NEW ADHESIVE

"Bonds anything to anything"—permanently

Now, for the first time, one cement for all purposes—light or heavy duty. Pliobond, developed by Goodyear, joins the following to themselves and to each other—permanently . . . metal, wood, plastic, plastic films, ceramics, glass, vulcanized rubber, paper, leather, plaster and wallboard, concrete. Pliobond is easy and ready to use; sets quickly; stays flexible, won't become brittle; resists water, gasoline, oils, chemicals, waxes. Widely used in industry. Try it. Brush-top bottles 25c and 50c at Woolworth's, Kresge's, Scott's, Goodyear Service Stores, hobby and hardware stores.

W. J. RUSCOE CO.
AKRON 13, OHIO

GOODYEAR ADHESIVE

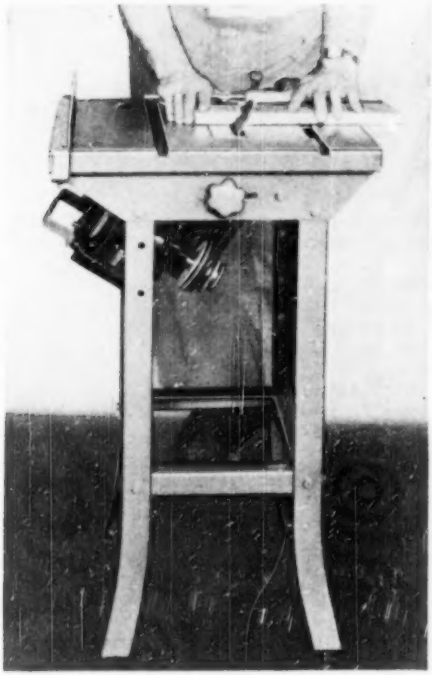
Pliobond

*TM The Goodyear T&R Co

New Tools

Pocket Torch. This automatic alcohol torch weighs only 10 oz. and measures 7¼" tall. But it throws a 6" flame at 1,800° F. and will operate for about one and a half hours. It has no moving parts. Made by Emil Greiner, of New York City, the torch is priced at about $4. It's fine for hard soldering.

Kit Offers Expanding Drums. With the five expanding-type drums in this 15-piece drum sander set you can sand in corners, on curves, high spots, and fluted areas, as well as on flat surfaces. Ten sanding sleeves—one fine and one coarse for each size drum—are provided. The drums fit any portable drill, drill press, flexible-shaft tool, or chucked arbor that has a ¼" or larger chuck. No adhesives are necessary: friction of the expanding-type drums holds the sleeves firmly. The Fil-Mar Products Company, of Akron, Ohio, prices the set at about $4.



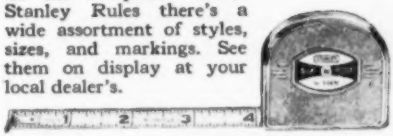
Low-Cost Floor-Model Saw. The price of this tilt-arbor saw—about $70—includes as standard equipment a ½-hp. motor, 8″ blade, miter gauge, rip fence, and a pressed-steel stand. Emrick, Inc., of Kalamazoo, Mich., is the manufacturer. The saw will make a 2¾″ cut when set at 90° and a 2⅛″ cut at 45°. All working parts of the arbor assembly are protected against sawdust and splinters. Belt tensioning is automatic. The table measures 20″ by 24″ and includes two miter-gauge slots.

Tool Removes Old Putty. Called the Putty Plow by its maker, the Apex Manufacturing Company, of Buffalo, N. Y., this tool has a steel blade that digs out old putty without marring the sash or endangering the glass. With the plow, you can clean out all four sides and the corners of a window frame and remove the glass without removing the sash. Price is about $1.50.

HANDY RULES

FOR HOME AND SHOP

In the complete line of Stanley Rules there's a wide assortment of styles, sizes, and markings. See them on display at your local dealer's.



STANLEY NO. 346 PULL-PUSH RULE. Rust-resistant spring steel blade — nickel plated or white enamel face. Large Gothic numerals — easy to read. Flexible-rigid blades for measuring straight, curved and angular surfaces. 6, 8, 10 ft. lengths.

STANLEY NO. 106 ZIG-ZAG RULE. All the features of 227 but without extension. White enamel finish.

STANLEY NO. 227 EXTENSION RULE. Solid brass extension for inside measuring. Selected sticks with new protective plastic finish. Coal black Gothic numerals. Graduated in 16ths — all edges. Rustproof nickel silver joints — "ball socket" action.

30 PRACTICAL PROJECTS

FOR YOUR WORKSHOP

Early American Designs — easy to make with hand or power tools. Two packets with 15 designs in each, 25c per packet, postpaid.

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Hardware • Tools
Electric Tools
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Stanley Tools, 2100 Elm St., New Britain, Conn.
(In Canada: Send to Stanley Tool Co. of Canada, Ltd., 114 Stanley St., Roxton Pond, Quebec.)

Please send me Series A ( ) and Series B ( ) of the new Early American Project Plans. I enclose 25c for each set.

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City.....State.....

P.S. Last minute news & notes...

THE GLARE of sun, snow, and approaching headlights is reduced by a new bluish-green glass that is being used for Buick windshields and windows. It also keeps out some of the sun's heat and the ultraviolet rays that cause upholstery to fade. A shaded green area at the top of the windshield makes an outside sun visor unnecessary.

THE WIND far above the highest-flying planes and balloons is now being measured. Three Stanford University men are noting it for the benefit of aircraft designers and weathermen. Their radarlike apparatus traces the electrical disturbances caused by meteoric dust. The way these disturbances drift reveals the speed and direction of the wind from 55 to 80 miles above us.

PRESS PHOTOGRAPHERS in Baltimore have been saving precious time by staying in the office and aiming their cameras at a television set (see page 128). They've covered such events as sessions of the United Nations Security Council--200 miles away--with the help of TV.

HOW DANGEROUS is it to bail out of a plane in an emergency? Navy records extending back five years show that three times as many men making emergency parachute leaps landed with only minor injuries--or none--as were killed or seriously injured.

JET ENGINES and wing-tip fuel tanks will soon be hung on DC-6 transports to boost their speed 100 miles an hour . . . Licensing of RAINMAKERS is being considered in California. . . . URANIUM, the stuff that the A-bomb made precious, is still being used to color false teeth.

WINDOW LIFTS in Chrysler Imperial models are electric now. There's a separate motor in each door, so trouble with one does not interfere with the other lifts. Raising or lowering a window takes no more electrical power than playing the radio for seven seconds.

PATENT NO. 2,510,061 fills a 366-page book, but you can buy a copy for 25 cents, the regular price for a copy of a U.S. patent. This one covers a device that tabulates and prints telephone bills automatically. An even longer patent was issued in 1937, however, on a weaving loom.

PAINTS in 2,000 tints, tones, and shades can be ordered by number from 37 charts that the Martin-Senour Co. and Container Corp. have prepared for dealers. The color-matching system used was described in Popular Science in September, 1946 (p. 104) . . . PLASTER made with perlite instead of sand has been found to resist fire better, provide more insulation, and lighten the load on walls. Perlite is a volcanic glass found in Arizona and New Mexico . . . Cows gave up to 50 percent more milk when switched from hard to SOFT WATER (see page 221 in this issue) in a recent midwest experiment . . . You can now get a BATHROOM MIRROR that won't fog from the Charles Parker Co., Meriden, Conn. It has an electric heater behind the glass . . . Winter-coat makers are now using a NEW FABRIC called Milium that has been sprayed with aluminum to reflect heat back to your body.

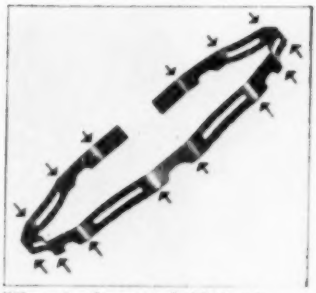
THE ATOMIC FURNACE at Brookhaven National Laboratory on Long Island is running now. Building and testing it took a year longer than experts expected (PS, Apr. '49, p. 121). . . . U.S. and British engineers now are rushing work on the plans for atomic boilers suitable for use in submarines. The British are trying to design a reactor that can be lifted out by a crane whenever it has to be refueled.

The Editors

MEET THE PISTON RING WITH A "DOUBLE-LIFE"

"'**Double-Life**' is the best way I can describe how Genuine Ford Replacement Piston Rings live a protected life while they are 'wearing-in,' and an extra-long, smooth-running life thereafter," the mechanic said.

"**During the first 'life,'** this cast-iron section of the 4-section Oil Ring extends slightly beyond the steel sections to seat the ring gradually and evenly before the harder steel touches the cylinder wall.



"**Then, in the second 'life,'** this expander section goes to work on the steel sections as well as the iron, with 14 points of contact, twice the usual number. Thus, it equalizes pressure against cylinder walls evenly and smoothly for maximum power, minimum oil use and quiet performance.

"**And this 'double-life'** benefit is not all! Every Genuine Ford Piston Ring is precision-built, with highest quality metals selected for strength, resistance to high temperature and wear. Yet a set of Genuine Ford Rings costs far less than any other replacement set for Ford engines."

"LIKE ALL GENUINE FORD PARTS, GENUINE FORD PISTON RINGS SAVE YOU TIME, MONEY AND MEAN REAL SATISFACTION!"

GENUINE Ford PARTS

Available wherever you see this sign at all Ford Dealers and selected independent garages.

KEEP YOUR FORD ALL FORD!

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Precision Lathes

For Better Machining

Whether you are doing production, maintenance, service or experimental work, you have need for South Bend Lathes. They produce better machining efficiently — especially when close tolerances are specified. Consequently, their use often results in appreciable savings in machining costs. And, being reasonable in price, they do not require heavy capital investment.

South Bend Lathes are your best buy. They're designed right — built right. Check coupon for complete information.

Building Better Tools Since 1906

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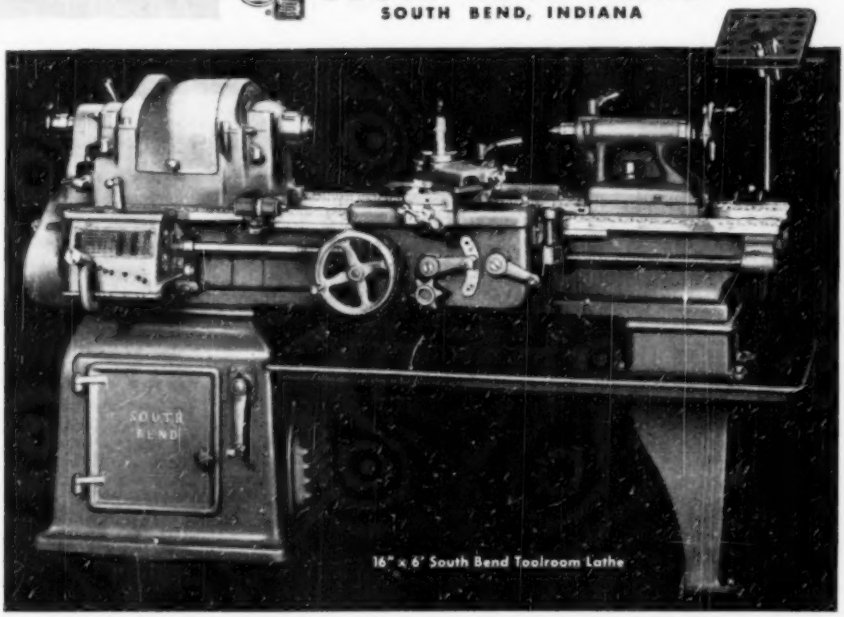


16" x 6' South Bend Toolroom Lathe

PRICES OF SOUTH BEND LATHES

LATHE SIZE	16" x 6'	14-1/2" x 5'	13" x 5'	10" x 3' 1" Collet Cap.	10" x 3' Light Tun	9" x 3'
QUICK CHANGE GEAR MODEL	$1902.90	$1613.90	$1350.90	$1017.40	$464.70	$368.70*
TOOLROOM MODEL	2360.90	2033.90	1748.90	1355.40	663.70	555.70

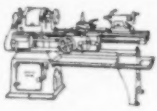
Above prices include 3 phase, 60 cycle motor and drum switch, f.o.b. factory.

** 9" Standard Change Gear Models priced from $176.00, less motor and switch.*

Send Information Checked:

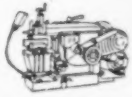
- ☐ 16" TOOLROOM LATHES
- ☐ LATHE TOOLS AND ATTACHMENTS
- ☐ TIME PAYMENT PLAN

☐ 9" and 10" BENCH LATHES



☐ 10" TO 16-24" FLOOR LATHES

☐ 14" DRILL PRESSES



☐ 7" BENCH SHAPER

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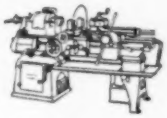
☐ TURRET LATHES ½" and 1" Collet



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"Am doing Radio Servicing full time. Have my own shop and am making more money now than I ever did before. Owe this to N.R.I."—Curtis Staeth, Fort Madison, Iowa.

N.R.I. Graduate Doubles Salary

"I am employed by Station WKBO, as transmitter operator. Have more than doubled my salary since starting in Radio full time."—A. A. Herr, New Cumberland, Pa.

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Learn by Practicin

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Do you want good pay, a bright future, and security? Want your own profitable shop? Get into fast growing, prosperous RADIO-TELEVISION! Radio alone is bigger than ever. $1 million home and auto Radios, 2,700 Broadcasting Stations, expanding Aviation and Police Radio, Micro-Wave Relay, Two-Way Radio are making opportunities for Servicing and Communications Technicians and FCC-Licensed Operators.

Television is TODAY'S Good Job Maker

In 1949 almost 3,000,000 TV sets sold. By 1954, 26,000,000 TV sets estimated. 100 TV Stations now operating. Authorities predict 1,000 TV Stations. This means more jobs, good pay for qualified men.

I'll Train You At Home in Spare Time

Keep your job while training. Hundreds of successful RADIO-TV TECHNICIANS I trained had no previous experience,

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Make Extra Money While Learning

Many of my students earn money fixing Radios in their Spare Time while learning, often average $5 to $10 a week. I send you SPECIAL BOOKLETS that show how to do it . . . and I send parts to build a MULTITESTER that helps you do it.

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$10 to $15 Week Spare Time

"4 months after enrolling for N.R.I. course, averaged $10 to $15 a week in spare time servicing Radios." — W. Weyde, Brooklyn, N.Y.

Shop Specializes In Television

"Have my own shop. Am authorized serviceman for 5 large manufacturers and do servicing for 7 dealers." — Paul Miller, Maumee, Ohio.

Calls N.R.I. His "Stepping Stone"

"N.R.I. has been my stepping stone from a few hundred to over $4,000 a year as a Radio Engineer. Make extra money servicing Radios."—Alton B. Michaels, Trenton, Ga.

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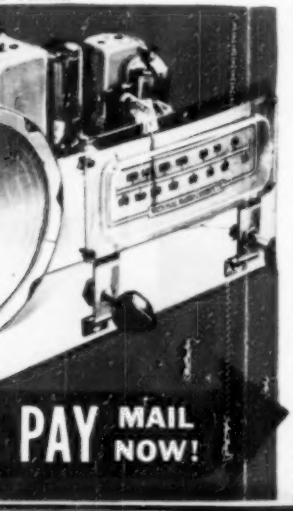
out and mail postcard at right for FREE DOUBLE OFFER Now! get actual servicing lesson to how you learn at home. Also 64-page book, "How to Be A Suc- in Radio-Television." Read what graduates are doing, earning; see pment you practice with at home. out and mail postcard . . . no post- stamp necessary. J. E. SMITH, ident, Dept OKP3, National Radio tute, Washington 9, D. C. OUR YEAR.



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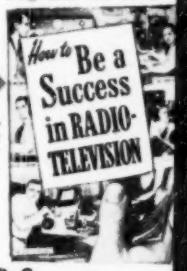

You also get my 64-Page Book on winning success in RADIO-TELEVISION. It tells more about YOUR opportunities, details of my course, what my graduates are doing, earning.

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You learn by practicing with Many Radio Kits I send. You build a superheterodyne Radio, Multitester, etc. Make $5, $10 a week EXTRA fixing Radios in spare time while learning. Cut out and mail card below now. Get actual lesson "The ABC's of Servicing" and 64-page book, "How to Be A Success in Radio-Television."

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from air before it enter

igible Engine Wear After 80,000 Miles

"My car was driven 80,000 miles before engine overhaul," says California motorist. "It was equipped with a Fram Oil & Motor Cleaner. When I tore motor down, only sludge was below oil pump about 5" in diameter and ¼" thick. Greatest wear on crankshaft was .0005". Reassembled motor using new rings, valves, guides, standard bearings. Later, on 3000 mile trip, added only one quart of oil. Now have 115,000 miles. Consider Fram Oil & Motor Cleaner best investment I ever made."

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Famous Fram Filcron Cartridges **are the working part of the filter. Remove harmful particles down to one micron (.000039") in size. Offer highest clean oil flow rate, maximum dirt capacity, longer cartridge life, lowest clean oil cost per mile. Exclusive non-abrasive filtering media . . . positively will not remove additives from compounded oils. Can be changed easily . . . quickly . . . economically when effective life is spent.**

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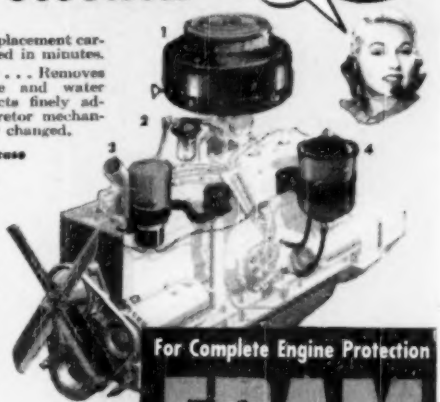
installed. Low cost replacement cartridge. Can be changed in minutes.

2. *Fram Gasoline Filter* . . . Removes dirt, sediment, scale and water from gasoline. Protects finely adjusted modern carburetor mechanisms. Cartridge easily changed.

3. *Fram Positive Crankcase Ventilator* . . . Combines a Fram Crankcase Air Filter with an electrically-driven blower. Provides continuous, uniform crankcase ventilation with clean, filtered air to remove corrosive blow-by gases as fast as they are formed. Seals crankcase against entry of dirt at all points. Flexible air hose and special cap fit on oil filler pipe. Cartridge can be changed in 30 seconds.

4. *Famous Fram Oil & Motor Cleaner* . . . as described above



Put all four of these Fram engine-savers on your car for Complete Engine Protection. For the name and address of your nearest Fram Dealer, call Western Union by number and ask for OPERATOR 25. **FRAM CORPORATION, Providence 16, R. I.** *In Canada:* **J. C. Adams Co., Ltd., Toronto, Ontario.**

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